

POPULAR SCIENCE

MONTHLY

Mechanics & Handicraft

SEPTEMBER

15¢



Can We Defend Our Coasts? PAGE 94

Now! Amazing Opportunity to Get Started in AVIATION!

**Prepares for Written
CIVIL AERONAUTICS
BOARD Examinations
for Pilot's License**

At last you can get ready, *right at home*, to prepare for a real job in the Aeronautical Industry—or to learn the principles of flying through these complete, *brand new* LECTURES IN AERONAUTICS! Written especially for The NATIONAL AERONAUTICS COUNCIL, by outstanding leaders in Civil, Military and Naval Aviation, assisted by dozens of top-rating Government specialists. With their authoritative help, you can now acquire a thorough foundation knowledge in every branch of up-to-date Aeronautics, and be ready for quicker progress as a flyer, airplane mechanic or expert factory worker.

If you are eager to fly, or to get a job in an airport or factory—but can't attend a technical school—you are one of those for whom the National Aeronautics Council has made this low-cost home instruction possible. After months of preparation, with thousands of dollars expended, it is now completed—and you can be among the *first* to benefit from this great achievement.

How Could It Be Done at Such Trifling Cost?

It was possible only because The National Aeronautics Council was able to secure the cooperation of the most famous and most highly qualified Civil, Military and Naval leaders. With their aid, 1028 lectures have been prepared which are outstanding in their broad scope, and unquestioned in authority. Famous authorities like Col. Roger Q. Williams, pioneer transatlantic pilot; Major Augustus Post; Dr. Jean Piccard; E. A. Link, inventor of the famous Link Trainer; and over 60 others, are among the contributors to this amazing home study instruction that you get for only 25 cents a week.

Weekly Lectures Instruct You in All Branches

In order to give you the advantage of learning several aeronautical subjects at the same time, each weekly issue of *Aeronautics* brings you lectures in four different main divisions of Aviation. They come to you for 54 weeks. This method not only gives you a fascinating variety in the subjects you are studying, but may enable you to select, *early in your instruction*, the particular branch of work you wish to specialize in:

MAJOR GENERAL JAMES E. FECHET, (Ret.), N.A.C.'s Advisory Editor for Military Aviation.

See the WIDE SCOPE of the 1028 Fascinating Lectures!

These are only a few of the fundamental subjects in which you will be instructed by outstanding authorities NOW ACTIVE IN AVIATION!

Theory and Practice of Flying

Civil Air Training Plan in National Defense (Requirements for enrollment — procedure of applicant — training plans.)
Military Training for qualified Civil Air Training Pilots (Qualifications — Extent of Training—Pilot Status at Completion of Course.)
Theory of Flight
Ground Training
Primary Flight Instruction
Advanced Flight Training
Army Flying Training
Light Plane Development
Light Plane Operation
Gliding and Soaring
The Pilot and His Parachute
Aerobatics
Civil Airway Regulations
Civil Airport Regulations
etc., etc.

Meteorology, Navigation and Instruments

Principles of Meteorology
Elementary Principles of Navigation
Navigational Instruments
Principles of Flight Instruments
Uses of Flight Instruments
Flying by Automatic Controls
Blind Flying
The Link Trainer
Radio Communications
Private
Flight Instruments
Engine Instruments
Navigational Calculators and Accessories
Airport Aids to Flight
Practical Notes on Sextants
Naval Air Organization
Shipboard Catapults
Aerial Photography
Blind Flying Instruction
etc., etc.

Airplanes, Engines and Accessories

Evolution of a Modern Transport Plane
Uses and Types of Military Airplanes
Private Aircraft
Principles of Aircraft Engines
Engine Types and Specifications
Engine Testing and Rating
Causes of Engine Failures
Engine Starters and Starting
The Diesel Engine
The Water and Chemical Cooled Engine
Fuel and Oil Systems and Installation
Retractable Landing Gear
Fixed Pitch Propellers
Variable Pitch Propellers
Routine Test Flights
Performance Test Flights
etc., etc.

Operations, Communications, General Applications, Military and Civil

Army Aviation Careers
Naval Aviation Careers
Civil Aviation Careers
Aircraft in National Defense
Defense Against Aircraft
Dive Bombing
Bomber versus Pursuit
Army Expansion Program
Airline Operation
Night Flying and Airport Lighting
Map Making from Air Photographs
Air Show Organization and Management
Aerial Forestry Patrol
Aerial Advertising
Plane Rental Service
Production Engineer
Television in Aircraft
Banner Towing
Sky Writing
etc., etc.

3456 Pages! 1500 Photo-Illustrations and Diagrams!

Only 25¢ a Week!

Stop Any Time You Like

Here is the Practical HOME INSTRUCTION that every air-minded man has longed to get!

This clearly written home-study instruction by outstanding active experts will give you a valuable head start—will help you to qualify more quickly for the job you want—will greatly speed up your progress toward the big opportunities opening up so rapidly in Aeronautics.

Over 1,500 photos, charts and diagrams. All through the lectures, clear pictures assist you in comprehending everything quickly and completely. Wherever a photograph or drawing will help, it is furnished. The specially prepared illustrations average 2 to a page, and add immeasurably to the fascination of the subjects. **And you get air photos and maps of 24 principal airports—without extra expense!**

Think of Getting Instruction from Such Authorities— for ONLY 25¢ a WEEK!

The authoritative character of the instruction in all the four main divisions—all through the whole 54 issues of AERONAUTICS—is guaranteed by the names of the Advisory Editorial Board shown at the right. Under the general supervision of this board, the lectures have been prepared by nationally prominent authorities, including 60 active Government specialists.

ENROLL NOW! 25¢ Starts You!

When you mail the coupon with only 25¢, you do not obligate yourself to accept all 54 weekly issues of this series. If you are not completely satisfied, you can stop when you please. All you have to do to satisfy yourself of its value to you is to pay a quarter for issue No. 1 containing the first group of lectures. (Handsome leatherette filing case available at trifling cost.) National Aeronautics Council, Inc., Dept. 809, 37 West 47th St., New York, N. Y.

Copyright, 1940, by The National Aeronautics Council, Inc.

The year's series of "Aeronautics" issues makes a marvellous REFRESHER COURSE for those who wish to brush up earlier training and bring themselves up to date in Aviation.

Never Before Such an Opportunity

At the present time all leading factories are steadily expanding their production of planes for both civil and government use, and rapidly increasing the number of jobs! You can learn about these jobs from these N. A. C. Lectures in AERONAUTICS.



More Than 60 Top-Ranking Experts

All nationally famous in civil, military and naval aviation, have prepared this course under the direction and editorship of the following board of eminent editors:

Advisory Editor for Civil Aviation

DR. ALEXANDER KLEMIN, Professor of Engineering and Chairman of Department, Guggenheim School of Aeronautics, N. Y. U.

Advisory Editor for Military Aviation

GEN. JAMES E. FECHET (Ret.), Formerly Chief of Air Corps, U. S. Army.

Advisory Editor for Naval Aviation

CAPT. HOLDEN C. RICHARDSON, Formerly Bureau of Aeronautics, U. S. Navy.

Do you know that wonderfully simple and safe "flier ships" are available FOR RENTAL in all parts of the country and that they cost you (everything included) only seven to nine cents a mile?

Wrap Up 25¢ and Mail It Now for Your First AERONAUTICS

National Aeronautics Council, Inc., Dept. 809, 37 West 47th St., New York, N. Y.

For the enclosed 25¢, please send me the first issue of AERONAUTICS containing the first group of lectures (THEORY AND PRACTICE OF FLYING; METEOROLOGY, NAVIGATION, AND INSTRUMENTS; AIRPLANES, ENGINES, AND ACCESSORIES; and OPERATIONS, COMMUNICATIONS, GENERAL APPLICATIONS) prepaid, and enroll me for one year. You may send me AERONAUTICS weekly at the rate of 25¢ a week until I give you notice to cancel my enrollment. For convenience in bookkeeping you may bill me once a month for such lectures as I receive. It is understood that I may cancel my subscription at any time and pay only for copies actually received.

Name..... Age.....

Address.....

City..... State

POPULAR SCIENCE

Founded 1872

MONTHLY
Mechanics & Handicraft

Volume 137, No. 3

RAYMOND J. BROWN, *Editor*

ARTHUR WAKELING, Home Workshop Editor

ALDEN P. ARMAGNAC, Associate Editor

GEORGE H. WALTZ, Jr., Associate Editor

SYDNEY OXBERRY, Art Editor

CONTENTS FOR SEPTEMBER 1940

Enlarging the Panama Canal.....	42
Flyers by the Ten Thousand.....	46
Cowboys on Wheels.....	52
Uncle Sam's Shooting Gallery.....	57
Is It Murder?.....	68
Field Trials Test Hunting Dogs.....	73
Paper Made from Clay.....	82
He Runs a Hotel for Bats.....	88
Can We Defend Our Coasts?.....	94
Grooming the Iron Cavalry.....	99
New Experiments with Rockets.....	108
Superhighway Pierces Mountains.....	126

ANIMALS

Dog Helps Train Race Horse.....	72
First "Seeing Eye" Dog Preserved.....	72

AUTOMOBILES

Garment Bags Fit Car Roof.....	124
Glasses for Color-Blind Motorists.....	124
Automatic Fitting Feeds Grease.....	125
Blackjack Shifts Gears.....	125
Safety Light for Arm Signals.....	125
How the New Cars Are Designed.....	127
Battery Tester Speeds Service.....	128
Rattleproof Coat Hooks.....	128
Sealed-Beam Conversion Kits.....	128
Car for Children Easy To Drive.....	129
Map-Reading Aids for Tourists.....	129
Gauge Checks Your Fuel Pump.....	130
Safety Reflector for Car Door.....	130
Lever Moves Car in Garage.....	130
Magnet Recovers Dropped Parts.....	131
Inner Tube Protects Bumper.....	131
Clothespin Starts Siphon.....	131
Grease Saves Fender Finish.....	131

AVIATION

Helicopter Flown Successfully.....	50
Truck Starts Airplane Engine.....	51
Naval Flyers Get Odd Baptism.....	51

HELPS FOR HOME OWNERS

Windows Slide Horizontally.....	22
Metal Edging for Lawns.....	22
Holder Locks Door Open.....	22
Screen Unrolls as Window Opens.....	24
Solvent Cleans Paint Brushes.....	24

(Continued on page 4)

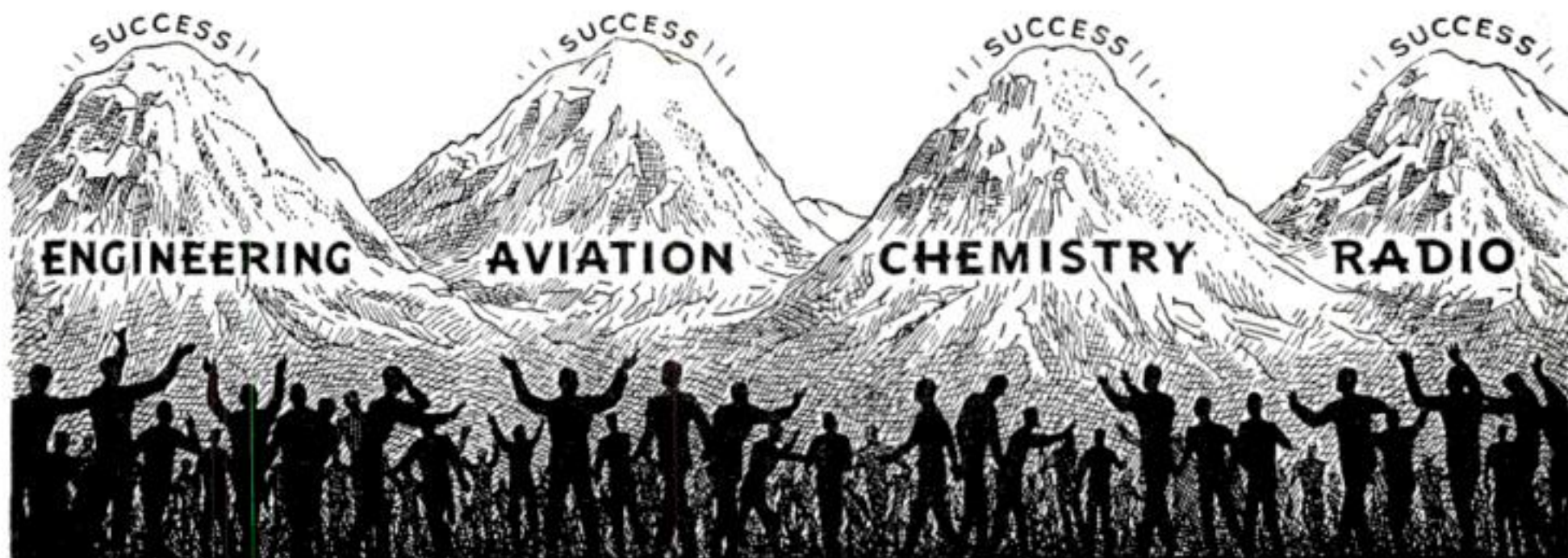
Features and Departments

OUR READERS SAY—.....	10
IDEAS FOR HOME OWNERS.....	22
HERE'S MY STORY.....	76
THE MAN WITH THE NET.....	115
POPULAR SCIENCE QUESTION BEE.....	116
UN-NATURAL HISTORY.....	117
NEW HOUSEHOLD APPLIANCES.....	120
GUS WILSON'S MODEL GARAGE.....	132
RADIO DEPARTMENT.....	194

THE HOME WORKSHOP begins on page 135

Published monthly at 353 Fourth Avenue, New York, N. Y., by Popular Science Publishing Co., Inc. Godfrey Hammond, President and Treasurer; R. C. Wilson, Vice President; Raymond J. Brown, Vice President; F. W. Briggs, Secretary. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U.S.A. Copyright, 1940, by Popular Science Publishing Co., Inc. All rights reserved in the United States, Great Britain, and in all countries participating in the International Copyright Convention and the Pan American Copyright Convention. Single copy, 15 cents; Canada, 20 cents. Yearly subscriptions to United States and its possessions, \$1.50; Canada, \$2.00; foreign countries, excepting Canada, \$2.50. Subscribers must notify us of change of address four weeks in advance of the next publication date. Be sure to give both old and new address. The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. Contributions not accompanied by sufficient postage will not be returned. In presenting numerous stories of new products of applied science, Popular Science Monthly does not underwrite the business methods of the individuals or concerns producing them. To avoid liability for patent infringement, readers should investigate before making, using, or offering for sale any of the devices, machines, or processes described; Popular Science Monthly takes no responsibility. The use of Popular Science Monthly articles for stock-selling schemes is never authorized.

THE SUN NEVER SHINES IN THE VALLEY OF IGNORANCE!



DEEP in that valley, the multitudes dwell in darkness. But a few have the courage and character to proclaim:

"We want SUNLIGHT! We're going up the hills—to the high peaks where the sun of SUCCESS shines bright!

"We've learned what it takes to ascend the hills . . . TRAINING! Training to do some one thing WELL! Training to win a greater share of the good things life offers! We're going to *get* that training!"

At this very moment, tens of thousands of ambitious men are enrolled with the International Correspondence Schools—getting the sound, practical TRAINING they need to succeed. They study texts so authoritative and up-to-date that scores of colleges have adopted them! They know that thousands of today's business leaders are former I. C. S. students! They've set out to climb high!

Where will you be—when they've reached the peaks? Mail this coupon *today!*

INTERNATIONAL CORRESPONDENCE SCHOOLS

BOX 7696-J, SCRANTON, PENNA.

★ Without cost or obligation, please send me a copy of your booklet, "Who Wins and Why," and full particulars about the course *before* which I have marked X: ★

TECHNICAL AND INDUSTRIAL COURSES

- | | | | | | |
|---|---------------------------------------|---|--|--|--|
| <input type="checkbox"/> Agriculture | <input type="checkbox"/> Air Brake | <input type="checkbox"/> Cotton Manufacturing | <input type="checkbox"/> Manufacture of Pulp Paper | <input type="checkbox"/> R. R. Signalmen's | <input type="checkbox"/> Refrigeration |
| <input type="checkbox"/> Air Conditioning | | <input type="checkbox"/> Diesel Engines | <input type="checkbox"/> Marine Engines | <input type="checkbox"/> Sanitary Engineering | |
| <input type="checkbox"/> Architectural Drafting | | <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Mechanical Drafting | <input type="checkbox"/> Sheet Metal Work | |
| <input type="checkbox"/> Architecture | | <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Mechanical Engineering | <input type="checkbox"/> Steam Electric | |
| <input type="checkbox"/> Auto Engine Tune-up | | <input type="checkbox"/> Fire Boilers | <input type="checkbox"/> Mine Foreman | <input type="checkbox"/> Steam Engines | |
| <input type="checkbox"/> Auto Technician | | <input type="checkbox"/> Foundry Practice | <input type="checkbox"/> Navigation | <input type="checkbox"/> Steam Fitting | |
| <input type="checkbox"/> Aviation | <input type="checkbox"/> Boilermaking | <input type="checkbox"/> Fruit Growing | <input type="checkbox"/> Patternmaking | <input type="checkbox"/> Structural Drafting | |
| <input type="checkbox"/> Bridge Engineering | | <input type="checkbox"/> Heating | <input type="checkbox"/> Pharmacy | <input type="checkbox"/> Structural Engineering | |
| <input type="checkbox"/> Building Estimating | | <input type="checkbox"/> Heat Treatment of Metals | <input type="checkbox"/> Plumbing | <input type="checkbox"/> Surveying and Mapping | |
| <input type="checkbox"/> Chemistry | | <input type="checkbox"/> Highway Engineering | <input type="checkbox"/> Poultry Farming | <input type="checkbox"/> Telegraph Engineering | |
| <input type="checkbox"/> Civil Engineering | | <input type="checkbox"/> House Planning | <input type="checkbox"/> Practical Telephony | <input type="checkbox"/> Textile Designing | |
| <input type="checkbox"/> Coal Mining | | <input type="checkbox"/> Locomotive Engineer | <input type="checkbox"/> Public Works Engineering | <input type="checkbox"/> Toolmaking | |
| <input type="checkbox"/> Concrete Engineering | | <input type="checkbox"/> Machinist | <input type="checkbox"/> Radio, General | <input type="checkbox"/> Welding, Electric and Gas | |
| <input type="checkbox"/> Contracting and Building | | <input type="checkbox"/> Management of Inventions | <input type="checkbox"/> Radio Operating | <input type="checkbox"/> Woolen Manufacturing | |
| | | <input type="checkbox"/> Managing Men at Work | <input type="checkbox"/> Radio Servicing | | |
| | | | <input type="checkbox"/> R. R. Section Foreman | | |

BUSINESS COURSES

- | | | | | | |
|--|--------------------------------------|--|---|---|--------------------------------------|
| <input type="checkbox"/> Accounting | <input type="checkbox"/> Advertising | <input type="checkbox"/> Civil Service | <input type="checkbox"/> First Year College | <input type="checkbox"/> Railway Postal Clerk | |
| <input type="checkbox"/> Bookkeeping | | <input type="checkbox"/> College Preparatory | <input type="checkbox"/> Foremanship | <input type="checkbox"/> Salesmanship | <input type="checkbox"/> Secretarial |
| <input type="checkbox"/> Business Correspondence | | <input type="checkbox"/> Commercial | <input type="checkbox"/> French | <input type="checkbox"/> Service Station Salesmanship | |
| <input type="checkbox"/> Business Management | | <input type="checkbox"/> Cost Accounting | <input type="checkbox"/> Grade School | <input type="checkbox"/> Sign Lettering | <input type="checkbox"/> Spanish |
| <input type="checkbox"/> Cartooning | | <input type="checkbox"/> C. P. Accounting | <input type="checkbox"/> High School | <input type="checkbox"/> Traffic Management | |
| | | | <input type="checkbox"/> Illustrating | | |
| | | | <input type="checkbox"/> Lettering Show Cards | | |

DOMESTIC SCIENCE COURSES

- | | | |
|---|---|---|
| <input type="checkbox"/> Advanced Dressmaking | <input type="checkbox"/> Home Dressmaking | <input type="checkbox"/> Tea Room and Cafeteria |
| <input type="checkbox"/> Foods and Cookery | <input type="checkbox"/> Professional Dressmaking and Designing | Management, Catering |

Name.....Age.....Address.....

City.....State.....Present Position.....

Canadian residents send coupon to International Correspondence Schools Canadian, Limited, Montreal, Canada
British residents send coupon to I. C. S., 71 Kingsway, London, W. C. 2, England

CONTENTS [Continued]

Chemical Kills Paint Smell.....	24
One-Coat Washable Paint.....	26
Ball-Bearing Faucet Washer.....	26

HOBBIES

Ornaments from Avocado Seeds.....	89
Tiny Museum Holds Rare Curios.....	90
Kit for Toothpick Engineers.....	91
Revives Horsehair-Weaving Art.....	91
Composer Collects Music Boxes.....	92

HOME AND FARM

Set Aids Home Decorators.....	119
Machine Sews On Buttons Quickly.....	119
Pads Keep Dogs' Coats Clean.....	119
Cutter for Vegetables.....	120
Ornamental Weather Forecaster.....	120
Picture-Frame Flower Vase.....	120
Line Needs No Clothespins.....	120
Clothes Tree Fastens to Wall.....	121
Shaker Gives Salt or Pepper.....	121
Hanger for Bridge Table.....	121
Versatile Chair Has Many Uses.....	121
Plants Boarded at Hothouse Hotel.....	122
Novel Process Keeps Milk Fresh.....	122
Model Homes Built with Kits.....	122
Horse-Meat "Worms" Fool Frogs.....	123

INVENTIONS

Fountain Pens Get Chemical Baths....	78
Hot-Air Cabinet Dries Fire Hose.....	78
Oil Heater and Stove Combined.....	78
Flame Thrower Curbs Forest Fire.....	79
Addressing Machine for Home.....	79
Plane Motor Has Few Parts.....	80
Beach Sunbonnet Is Collapsible.....	80
Novel Clarinet Is Transparent.....	81
Electric Stop Watch Easy To Read....	81
Sponge-Rubber Building Set.....	81
Trucks Aid War on Mosquitoes.....	83
Charts Make Midget Planetarium.....	84
Refrigerator for Airplane Rivets.....	84

LABORATORY NEWS

Model Shows Tooth Formation.....	103
How Plant Doctors Protect Crops.....	104
Scientists Run Mouse-Trap Line.....	106
Rubber Film Preserves Specimens.....	107
X Rays Spot Decayed Poles.....	107

MILITARY

Tank Engines Repaired in Field.....	93
Fast Patrol Boat Joins Navy.....	93
Coast Guard Patrols Sea Lanes.....	98
Odd Mine Has Electric Ears.....	102
U. S. Gets New Antiaircraft Gun.....	102

ODDITIES

Spade with Two Handles.....	115
Prehistoric Sun Spots Traced.....	115
Coal Mined from River Bed.....	118
Rotary Tables Speed Production.....	118

PHOTOGRAPHY

Enlarger Fits Traveling Case.....	111
Sensitizer Comes in Capsules.....	111
Projector and Viewer in One.....	111
Ferrotyping Tinted Photographs.....	112
Meter Shows Negative Density.....	112
Compact Developing Tank.....	112
Improved Photoflood Bulbs.....	113
Pilot Beam Trains Flash Gun.....	113
Adapters for Midget Bulbs.....	113
Remote-Control Studio Camera.....	114
Adapter Ejects Used Flash Bulbs.....	114
New Enlarging-Paper Envelope.....	114

SPORTS

863 Floodlights Shine on Diamond.....	56
Novel Controls for Fishing Boat.....	65
Motor Unit for Bicycles.....	65
Trap on Gun Hurls Clay Targets.....	66

YOU

Toy Balloons Aid Opera Singer.....	85
Vibrating Brush Massages Scalp.....	85
Handy New Desk Cover.....	85
Sun Glasses Regulate Light.....	86
Musical Pitch Is Broadcast.....	86
Paddles Provide Cool Massage.....	86
Jewelry of Gold-Plated Glass.....	87
Safety Razor Trims Corns.....	87
Cigarette Case Tallies Handouts.....	87

CAMERA HINTS

Stopping Action with a Camera.....	182
Scoop Gets into Small Bottles.....	184
Cork Keeps Dust from Film Tank.....	184
Metronome Times Print Exposures.....	184
Wet Prints Trimmed with Knife.....	185
Finger Cots Protect Your Film.....	185
Wire Stiffens Lamp Gooseneck.....	214
Film Slides Readily into Reel.....	214
Christmas-Tree Bulbs for Darkroom....	214
Dodging Mask Aids Enlarging.....	215
Filing Negatives with Data Cards.....	216
Tray Catches Spilled Developer.....	216

CRAFTWORK

Plastic Marine Luncheon Set.....	172
Leather-Covered Stationery Box.....	173
Two Bowls Form Fruit Holder.....	173
Table Holder for Paper Napkins.....	174

(Continued on page 6)

In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions



The Voice with a Smile

"We hold," says a well-known writer, "that the young ladies of the American long distance telephone wires make up what is probably the most efficient public service crew in the world. They have profound patience and that capacity for taking pains that some one once said is all that genius amounts to."

"We once called a fellow at a hotel in Philadelphia but he had just departed on an automobile trip in a westerly direction. A few days later the long distance operator caught up with him in a little town in Missouri and he was the most surprised man in all but one of the States of the Union. The exception was New York. We were the most surprised there. To this day we have no idea how the operator did it."

DAMON RUNYON
in the *New York Mirror*

BELL TELEPHONE SYSTEM



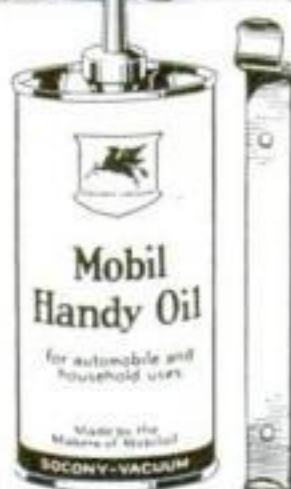
• *The Bell System cordially invites you to visit its exhibits at the New York World's Fair and the Golden Gate International Exposition, San Francisco.*

KEEPS MODELS RUNNING *SMOOTH!*



MOBIL HANDY OIL

It's penetrating, non-gumming. Keep it on hand for lubricating home appliances, sewing and washing machines, bicycles, toys. Fine for automobile generators and tools. Convenient wall clip free with every can.



ADD THIS TO YOUR GASOLINE!



Mobil Upperlube reaches the engine as a vapor. Special impregnating ingredient is adsorbed by metal surfaces, protects rings and valves from rust and wear.

MOBIL UPPERLUBE

Buy where you buy Mobiloil or Mobilgas

Mobil Specialties

MOBILGLOSS · MOBILWAX · MOBIL STOP-LEAK
MOBIL HANDY OIL · MOBIL RADIATOR FLUSH
MOBIL WINDOW SPRAY · MOBIL UPPERLUBE
MOBIL HYDROTONE · MOBIL SPOT REMOVER



BY THE MAKERS OF MOBILOIL

CONTENTS [Continued]

Shelf Contains Its Own Brackets.....	174
Copper Bracket Holds Ivy Pot.....	175
Toast Rack Made of Walnut Disks.....	176
Game Tests Steadiness of Hand.....	177
Silhouette, "Fireside Comfort".....	177

ELECTRICAL

Fluorescent Lighting Fixtures.....	178
Foil Shade Acts as a Reflector.....	180
Fish Tape Coiled Through Conduit.....	181
Brass Clips Fasten Wires Quickly.....	181
Soldering Copper Heats "Furnace".....	181

HOME SCIENCE

Film Viewer Identifies Stars.....	190
Neon Glow Lamp Tests Circuits.....	191
Oily Rags Are Really Dangerous.....	191
How to Prepare Bacteria Slides.....	192
Bacteria under the Microscope.....	192

MODELS

Paper Hulls for Speed Boats.....	186
Electric Starter Spins Propeller.....	188
Painted Scene Sets Off Layout.....	188
Authentic Railway Signposts.....	204
Miniature Fleet Built with Kit.....	210

NEW SHOP IDEAS

Draw-In Chuck and Spring Collets.....	148
Miter Jig for a Circular Saw.....	152
Wrench Holds Rods for Threading.....	152
Rack Protects Bits from Damage.....	153
Two Tapers Turned on One Piece.....	153
Rubber Hose Holds Shop Towel.....	153
Small Grinders from Old Wheels.....	153
Arbor Holds Faceplate or Chuck.....	154
Compact Way to Coil Solder.....	154
Brush Presses Tube Against Wheel....	155
Old Lamp Used as Lathe Light.....	155
Marking Very Thin Metal Shims.....	155
Shop Sayings of Old Bill.....	212

OUTDOORS

Diving Goggles Have Wood Frames....	165
Hose Used as Golf Practice Ball.....	166
Clamps Aid Lapstreak Planking.....	166
Grinder Sharpens Farm Tools.....	166
Tent Pegs Cut from Bamboo Poles.....	167
Inner Tubes Cut into Sandals.....	167
Vine Awning Changes with Seasons....	167
How to Make and Throw Boomerangs	168
Swing Holds Up Sifting Screen.....	169
Lawn Bowling with Wooden Disks.....	170
Sunglasses for Emergency Use.....	170
Targets Carried on Stretcher.....	171

(Continued on page 8)



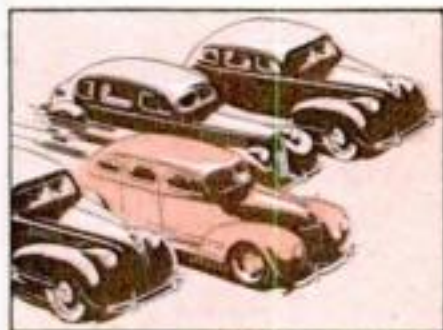
**"IMAGINE! HE SAID
MY CAR HAD NO
OOMPH!"**

How does this new kind of spark plug make cars run so much better?

NO WONDER car owners are astonished when sluggish, peepless motors suddenly take on new life! Thousands are finding new Auto-Lite Spark Plugs end starting troubles, give flashing pickup and power and restore gasoline economy.

For the new Auto-Lite Spark Plug was expressly designed to improve car performance by stepping up the efficiency of the entire ignition system. It employs a new-type Konium electrode with a new geometric gap design that produces a more effective spark with less effort. It is protected against leakage and cracking by the wonderful new "Ziramic" insulator with its triple seal.

See why owners of all makes of cars are so enthusiastic about Auto-Lite performance. Try a set of new Auto-Lites in your car today!



ONE OUT OF EVERY FOUR NEW CARS is now factory-equipped with Auto-Lite Spark Plugs. They have been adopted by leading car manufacturers after the most exhaustive and convincing tests.

THE ELECTRIC AUTO-LITE COMPANY
Merchandising Division
TOLEDO, OHIO **SARNIA, ONT.**



**HOW A SERVICE MAN'S ADVICE GAVE
A LAZY MOTOR AMAZING NEW LIFE**



"SOUNDS BAD, MISS!" said the service man. "What sounds bad?" I retorted. "This engine," he said. "Missing—no oomph. What new Auto-Lite Plugs wouldn't do for this car!"



"AREN'T ALL SPARK PLUGS ALIKE?" I said. "No, MAM! You'd see, the minute you changed to Auto-Lites! Save gas, too." "Alright, smarty, put in your magic Spark Plugs," I said.



"THANKS FOR THE OOMPH!" I shouted a few days later. The motor never had such pickup, never ran so sweetly. He won a steady customer with those new Auto-Lites.

Ignition Engineered by Ignition Engineers

Change to **AUTO-LITE SPARK PLUGS**

THINK OF YOUR FUTURE

AND GET INTO ELECTRICITY

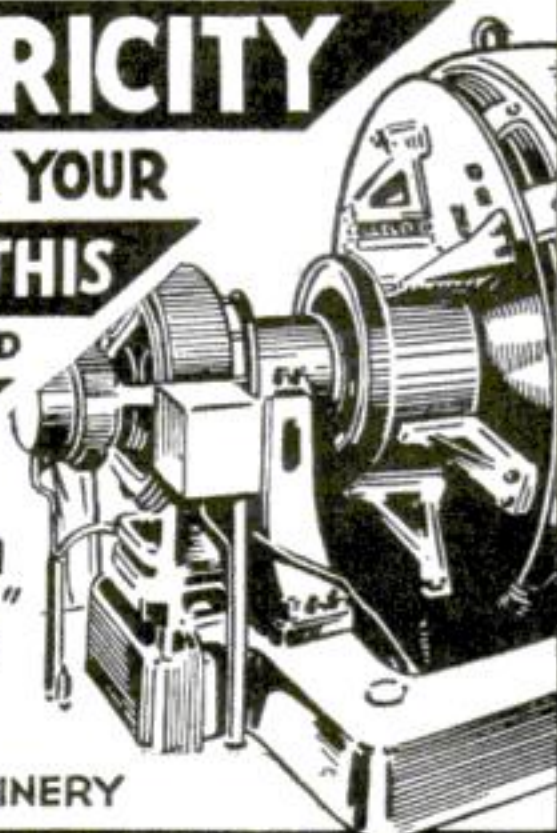
TRAIN FOR YOUR START IN THIS

GROWING FIELD

A QUICKER
EASIER

WAY "LEARN
BY DOING"
ACTUAL WORK
ON ACTUAL
ELECTRICAL

MACHINERY



12 WEEKS SHOP TRAINING PAY AFTER GRADUATION

If you are not getting ahead—if your dreams for the future are not panning out and you really want to get ahead—quit dreaming and do something about it. Get into a field where the opportunities are great and better salaries are paid. Get into Electricity.

The huge billion dollar Electrical Industry is full of opportunities for men and young men who are prepared to take advantage of them. Build the foundation for a better job or a business of your own in this growing field by training. You must be trained to get ahead.

The famous Coyne Shops in Chicago can train you for your start in only 12 weeks—NOT by home study BUT ON REAL ELECTRICAL EQUIPMENT and you "Learn by Doing".

YOU DON'T NEED PREVIOUS EXPERIENCE

You don't need previous experience—you don't need advanced education. At Coyne you are trained on real motors, dynamos, generators.

You wind armatures, do house wiring, operate switchboards, work on electric refrigeration and air conditioning equipment, farm lighting plants, automobile ignition and many other branches of Electricity.

EXTRA 4 WEEKS RADIO COURSE INCLUDED

Right now along with my regular Electrical Course I am including an Extra 4 Weeks Radio Course at no extra tuition charge.

"PAY AFTER GRADUATION" PLAN

I have a plan to help ambitious fellows who are short of money for their tuition. On this plan you can get your training first—then pay for most of it later in 12 monthly payments starting 5 months after you start school, or 60 days after your training period.

SEND THE COUPON FOR MY BIG FREE CATALOG AND ALL THE FACTS—TODAY!

H. C. LEWIS, President

COYNE ELECTRICAL SCHOOL
500 S. Paulina St. Dept. 60-73 CHICAGO

H. C. LEWIS, PRESIDENT,
COYNE ELECTRICAL SCHOOL
500 S. PAULINA ST. DEPT. 60-73
CHICAGO, ILLINOIS

Please send me your big free catalog and all the facts about Coyne Training and about your Extra 4 Weeks Radio Course.

NAME.....

ADDRESS.....

CITY.....STATE.....



**MAIL
COUPON
TODAY**

CONTENTS [Continued]

Giving Liquid Medicine to a Dog.....	171
Rubber Knee Bands Repel Briers.....	171

RADIO

Weighted Knob Simplifies Tuning.....	194
Switch Controls Five-Coil Set.....	194
Amateur's Television Camera.....	194
Fish Pole Used as Car Antenna.....	195
Spiral Brush Cleans Radio Jacks.....	195
Static Muffler for Auto Radio.....	195
Get Started in Radio for \$8.95.....	196
Pocket Receiver for Sports Fans.....	199

SHOP DATA FILE

Planing End Grain of Wood.....	147
An Ink for Marking Metals.....	154
Lubricants for Drilling.....	155
Coloring Metal Brown or Green.....	176
Flexible Electric Cords to Use.....	180
Exposures to Stop Action.....	183
Retouching Prints, Part I.....	185

THE HANDY MAN

Painting Questions and Answers.....	156
Work Flag Set Up on Shovel.....	159
Tool Cleans Cracks in Plaster.....	159
Removing Postage Stamps Quickly....	159
Casein Cement Fastens Handles.....	159
Keeping the Home Shipshape.....	160
Fluted Pin Rolls Fancy Cookies.....	162
Clip Keeps Tape from Unwinding.....	162
Length Gauge Clamps on Yardstick....	162
Arms of Easy Chair Re-Covered.....	163
Hose Section Used as Finger Vise.....	163
Keeping a Dial Phone in Place.....	163
Nail Stuck to Hammer for Starting....	163
Tilting Nail and Screw Holders.....	163
Hot Wire Solders Tiny Articles.....	164
Percolator Serves as a Gluepot.....	164
Repairing Rusted Feet of Tubs.....	164
Altered Knife Scrapes Cans.....	164
Rubber Handles Improve Files.....	164
Trellis Opens to Fit Any Space.....	202
Toothbrushes Made into Handles.....	202
Turning Rosettes from Wood.....	204

WOODWORKING

How to Lay Out Your Workshop.....	136
Baseboard Bends to Fit Wall.....	140
Warm Iron Smooths Sanding Disk.....	140
Using Blowtorch Near Woodwork.....	140
Cut-Off Gauge for Circular Saw.....	140
Planing Vise Adjusts to Any Wood....	141
Hanging Wall Rack for Ornaments....	141
Boy's Nautical Toy Chest.....	142
Gun Cabinet of Knotty Pine.....	144
Gauge Simplifies Panel Marking.....	145
Drafting Table for Use at Home.....	146
Stripes of Paint Anchor Nuts.....	147
House Jack Acts as Veneer Press.....	147

IT'S EASY TO PUT THIS *New 1941* *Midwest* IN YOUR OWN CABINET

**FACTORY
TO
YOU**



**SAVE
UP TO
50%**

**COMPLETE CHASSIS
WITH TUBES
AND SPEAKER**

Only **\$19⁹⁵**

**30 DAYS TRIAL
EASY TERMS**

14-TUBES
with

AMAZING FOREIGN RECEPTION

**FREQUENCY MODULATION
AND TELEVISION PROVISION**

NOW, you can enjoy the mighty power of a 14-Tube radio, at the amazingly low, factory-to-you price of only \$19.95. Brilliant performance. Beautiful tone. Now tune in broadcasts direct from distant overseas stations. Our famous 30-day prove-it-yourself plan, fully protects you and enables you to prove Midwest's super performance in the privacy of your own home, without obligation.

USERS SAY:

"Wouldn't Trade For Any Other Radio"



Milwaukee, Wis.—I wouldn't trade my Midwest for any other radio. It is my second Midwest and it is improved a lot, especially the foreign stations like Italy, France, Spain, England, and Germany, etc.
—S. Caplan.

"Voices and Singing Crystal Clear"



Bethlehem, Pa.—So crystal clear and natural that one would think the person speaking or singing was right in the living room. Foreign stations come in so clear, almost like any station in the U. S. A.—Mr. and Mrs. W. Frank.

YOU BE THE JUDGE

No high pressure salesmen are needed to urge you to keep a Midwest—its performance speaks for itself. Do like thousands have done—put this new 1941 chassis in your present cabinet. Other chassis and cabinet models are fully pictured and described in our new 1941 Factory-To-You, money-saving catalog . . . from 5 to 17 Tubes, and up to 5-Wave Bands . . . including Radio-Phonograph combinations and Home Recorders.

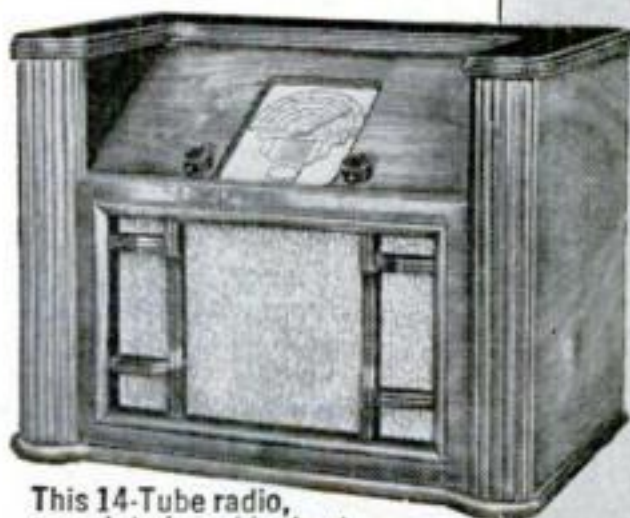
BRINGS IN WORLD NEWS DIRECT

Tune in broadcasts direct from foreign countries. Hear history in the making before it appears in your local paper, and, before your local station announces its own version of the news! Listen direct to distant overseas stations in remotest parts of the globe.

14-TUBE

**CABINET
MODEL**

\$29⁹⁵
COMPLETE



This 14-Tube radio, complete in cabinet, at a price you would ordinarily pay for a set with only 7 to 10 tubes.

**RUSH
COUPON**

**FILL IN COUPON AND MAIL TODAY OR JUST
SEND YOUR NAME AND ADDRESS ON 1¢ POSTCARD**

MIDWEST *Factory-to-You* RADIOS

MANUFACTURERS OF QUALITY RADIOS SINCE 1920

Midwest Radio Corporation
Cincinnati, Ohio, U. S. A.
Dept. 59-CC

Send me your new FREE Catalog, complete details of your liberal 30-day Trial offer and factory-to-you prices.

Name.....

Address.....

Town.....State.....

User-Agents Make Easy Extra Money. Check here () for details.

**FREE
RADIO
CATALOG**

**FOR FREE CATALOG
ON COMPLETE LINE OF
5 TO 17-TUBE MODELS**

**GET MIDWEST'S
ANSWER TO
TRADE-INS!**

Our Readers Say



Believe in Miracles? Read This Anyway!

SUPPOSE you were watching a building going up, and your eye happened to fall upon a stray brick lying on the ground. What would be your feelings if you saw that brick suddenly rise and sail through the air into the hands of a bricklayer on the third floor? No, you wouldn't be seeing things, according to a book I've just been reading. It could

AW SAVE TIME AND USE
ONE BIG ZERO!



happen perfectly naturally, and the reason is simple. The brick consists of innumerable atoms, moving every way at random. By pure chance, there is always the possibility that "once in a blue moon" the atoms might all jump the same way simultaneously. And presto—the brick goes soaring aloft! How remote is

the possibility? Well, a mathematician named Perrin has taken the pains to figure it out. According to his calculations, a brick might be expected to act in this astounding way just once in the number of years represented by one followed by ten billion ciphers. So you can safely bet against it; but it would still be just as likely to happen in 1940 as, say, in the year 100,000 A.D. Sort of makes you believe in miracles, doesn't it?—A. G. B., Sacramento, Calif.

It Wasn't a Hunting Trip, But He Shot the Sun

COMING out of the woods after a week's camping trip recently, I began to worry about whether I would catch the train that would take me back to civilization. I had a watch with me, but it had had such rough treatment that I could not be sure that it was within an hour of the correct time. So, to reassure myself, I "shot the sun" at noon by observing when it cast the shortest shadow. Knowing that I was right on the eastern edge of the Central Time Zone, I was able to figure pretty closely the time when the sun should reach the meridian, and found that my watch was within five minutes of the correct time. It amused me to think that I was just reversing the method by which navigators determine their longitude. Also, it made me think a whole lot more of my faithful old watch. P.S.: I made the train.—L. T., Asheville, N. C.

(Continued on page 12)

There's No Telling What You May See in This Picture

THE longer I looked at the photograph in the lower right-hand corner of page 153 in the August issue, the more familiar faces I saw in it. First it was Herbert Hoover. Then the inscrutable stare of the Sphinx. Popeye the Sailor emerged after a while, and then Winston Churchill. The famous Cheshire cat, no less famous for the Tenniel illustration of it, grinned out at me after a while, and, well, give it a try yourself. No matter whom you may see, he or it, as the case may be, is sticking his tongue out at you. The contributor who submitted this item deserves a bonus for packing so much material into a wrinkled paper bag and a bent clothes hanger.—S. J. S., Ann Arbor, Mich.

I'VE GOT 'EM AGAIN,
IT USE TO BE PINK
ELEPHANTS!



Why Photographers Turn Gray— That Is, One of the Reasons!

WILL some camera fan please come to my assistance with a plan! Anything short of a traveling darkroom will do, so long as it is foolproof. You see, last night I went to work with all the equipment I own to get one *good* picture of my eight-week-old offspring. Flash bulbs, reflectors, wiring, lens shade, exposure tables, camera, tripod, and so forth, were made ready with the greatest of care. The "sitting" was unusually simple and coöperative, considering the subject's usual and somewhat precocious distrust of a camera lens. (He'll never "go Hollywood" on me.) When all finished, I repaired to my darkroom and unloaded my cut-film holders—all twelve of them. Nine were empty. You see, in my enthusiasm for the task in hand, I completely forgot that I'd done some picture taking and developing a week ago and had not reloaded afterward. All I ask is something to put on each film

WHY NOT JUST INVENT
A MACHINE TO DO ALL
OUR THINKING
FOR US?





Plan Your Future

Choose Your Field NOW For Success

Will you master fate or will fate master you? That's a question deserving your honest answer...right now! Actually it is largely up to you. You can do with Life almost what you will. LaSalle will help you establish yourself for real success by providing you with the comprehensive, specialized training for which it is so famous. Choose your field...now! Check the coupon below for the free booklet you want us to send you. It can be your first step toward assured success.

Opportunities in Traffic Management

The field of Traffic Management offers real opportunity only to the man who knows. Spare time study and the will to succeed have pushed scores of Traffic employees up the ladder to financial success. Many LaSalle-trained traffic managers—both in the railroad and industrial field—now command salaries of \$3,000.00 to \$5,000.00 a year—and better. Investigate. Find out how you can qualify for these higher positions through LaSalle home-study and guidance.

Law for Business Success

And it isn't necessary to practice law to get this Success. In fact probably most of the men who study law today have no idea of taking the bar examination or becoming lawyers—they want law training to give them mastery of men and situations in business. You know that—

- (1) the man with legal training is a leader—not a follower.
- (2) legal training keeps your mind—clears away the problems that stump the ordinary fellow and makes you master instead of man.
- (3) knowledge of law simplifies the complications of executive work.
- (4) Many top executive places are filled by men who have studied law.

No matter whether you are in a big corporation or a small business—in a great city or a little town—a practical knowledge of law cannot fail to be of real and vital help to you in making a more successful career.

In every state in the union you'll find law-trained men who came up through LaSalle. What others have done, you can do.

And LaSalle offers either a full law course leading to LL. B. or a shorter business law training—whichever you prefer. All text material, including valuable 14-volume Law Library. Training comprises the most effective features of modern law instruction.

Executive Training

Executives who are efficient managers command responsible positions and good incomes. And the need for

trained executives is growing rapidly. We train you thoroughly at home in your spare time for every type of executive work—teach you the principles and practices used by our most successful business leaders and help you develop your management capacity—by a training built with the aid of outstanding executives.

Become an Expert Accountant The Profession That Pays

The demand for skilled accountants—men who really know their business—is increasing rapidly. New state and federal legislation requires much more, and more efficient accounting from business—big and small. Corporations are in constant need of expert counsel in matters relating to Auditing, Cost Accounting, Business Law, Organization, Management, Finance. Men who prove their qualifications in this important branch of business are rapidly promoted to responsible executive positions—given an opportunity to earn real salaries. The range is from \$2,000.00 to \$10,000.00 a year—even to higher income figures.

Under the LaSalle Problem Method you can at home acquire a thoro understanding of Higher Accountancy, master its fundamental principles, become expert in the practical application of these principles—this without losing an hour of work or a dollar of pay.

Your training will be under the direct supervision of a staff of legal, organization and management specialists, business efficiency engineers and Certified Public Accountants.

Preliminary knowledge of bookkeeping is unnecessary. We train you from the ground up, or from where you now are, according to your individual needs.

Mr. Salesman: What's Wrong?

Why aren't you making more sales—more money? Is it you—or your proposition? Check up first on yourself. Other men—no better than you—have found their earnings jump and stay up when they trained with LaSalle. Literally thousands of men—many of them years at the game—have increased their sales volume and earnings through home study with LaSalle guidance. Sound—practical—usable—right from field experience. Train for top-notch production with LaSalle.

LASALLE EXTENSION UNIVERSITY A CORRESPONDENCE INSTITUTION Dept. 983-R CHICAGO

I would like to have your special booklet—without any cost or obligation to me—about my opportunities and your success training in the business field I have checked.

- | | | |
|---|--|--|
| <input type="checkbox"/> Higher Accountancy | <input type="checkbox"/> Commercial Law | <input type="checkbox"/> Business English |
| <input type="checkbox"/> Law: Degree of LL.B. | <input type="checkbox"/> Expert Bookkeeping | <input type="checkbox"/> Business Correspondence |
| <input type="checkbox"/> Traffic Management | <input type="checkbox"/> C. P. A. Coaching | <input type="checkbox"/> Effective Speaking |
| <input type="checkbox"/> Modern Salesmanship | <input type="checkbox"/> Industrial Management | <input type="checkbox"/> Stenotypy |
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Modern Foremanship | |

Name.....Age.....

Position.....Address.....



Our Readers Say (CONTINUED)

holder that will shout out loud when I pick it up whether it is empty, or loaded and unexposed, or loaded and exposed. What to do! —T. U., Columbus, Ohio.

Winging Pop Bottles at the Ump Teaches Us Something

ON TURNING to page 87 of the August issue, I was amused by the picture of a soldier from some European army testing an antitank bomb consisting of a pop bottle filled with an inflammable liquid. Maybe it isn't very

HOPE THIS LOOKS GOOD IN THE NEWSREELS!

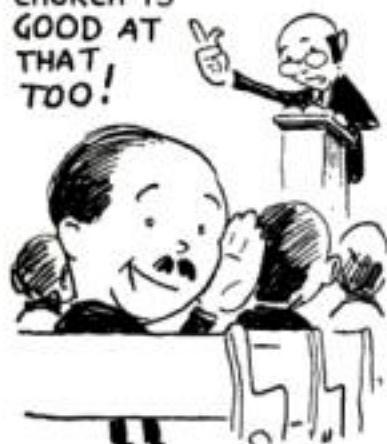


polite to laugh at others, but I got a good laugh at the pose the soldier is striking as he throws (?) the bomb. Left hand on hip, he has just let fly with the bomb by a sideward flick—just that—of his right arm. Any American boy between six and sixty who threw anything with that technique would be laughed off

the sand lot, and any baseball fan between Brooklyn and Podunk Center who couldn't wing a pop bottle with more finesse at an umpire, wouldn't even be allowed in the bleachers.—E. S. B., St. Louis, Mo.

Insomnia Is No Problem—in the Classroom!

CHURCH IS GOOD AT THAT, TOO!



THERE'S nothing new under the sun. In your August issue, you tell about a college course given at Columbia University which makes students sleep soundly. That's old stuff. We have professors at my college who have been doing that for twenty or thirty years—and without trying!—E. M. J., New York City.

First Bullet, O. K., Second Bullet, Ixnay!

JUST received July issue of P.S.M. today and am enjoying it very much. I always read it from cover to cover. Particularly interesting is the Gus Wilson Model Garage story, Our Readers Say, and With the Inventors. One thing amuses me this month in the latter. It is the military helmet designed by Percy L. Crosby that is supposed to bounce bullets aside. After looking it over, I found

(Continued on page 14)

myself wondering just what would happen if a second bullet came along before the crown was pulled back to the brim of the hat by the coil springs—M. L. Z., Taneytown, Md.

Don't Smash Any Umbrellas Figuring This One Out

THE trouble with N. S.'s little algebra problem, proving by algebraically correct steps that 1 is equal to 2, lies in the fact that the factor $(1-x)$, on each side of his equation $x(1-x) = (1+x)(1-x)$, is equal to zero; this because x equals 1, as given, and $1-1$ equals zero. Now anything multiplied by zero equals zero, so the other factors need not be equal. They were not, as it turned out, and the equation boiled down to the obvious error. It seems to be



customary to answer one problem with another, so I retaliate with one involving a bit of trigonometry: A nine-ribbed umbrella is stripped of its fabric covering so that its ribs are straight even when they open. They are opened so that each rib makes an angle of $15^\circ 13'$ with the center stick. Find the angle any rib makes with one next to it, and I hope it doesn't rain before you get a new umbrella.—P. M. D., Columbus, Ohio.

He'd Like To Read a Story on Nonfraudulent Spiritualists

SOME time ago, you published an article in your magazine exposing the methods employed by fraudulent spiritualists. I should like to see another article covering phenomena which have not been proved fraudulent, and possible scientific explanations. This would prove very interesting, as would an article on present-day findings in the realm of mental telepathy. Incidentally, your new arrangement makes things of interest much easier to find, in my opinion.—W. S. P., Corry, Pa.



That Article on Future Cars Is Still Hitting on All Cylinders

MY MORNING paper recently summarized a talk made by David Beecroft, a past presi-

Step Up Where You Belong

What Is Your Present Level of Preparation?

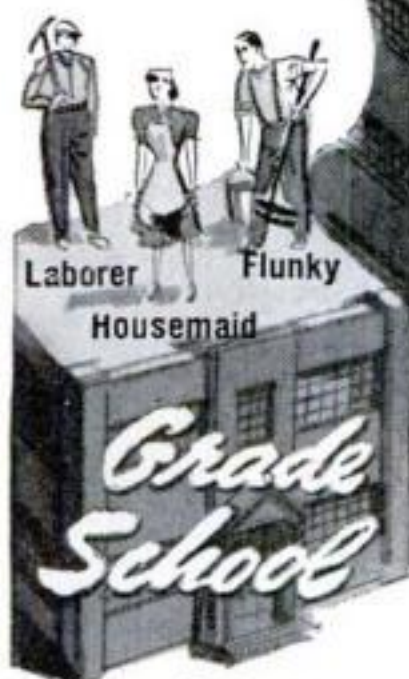
The **FIRST** proof of personal ability is your capacity to see the *need* for training and to **GET IT**. The man or woman who doesn't *realize* that education is **VITAL** to success—or who says he or she "doesn't have time," "hasn't the money" or that study is "too hard"—simply lacks one of the *fundamentals* of the **ABILITY** to make good. *American School (Chicago) graduates* by the thousands have **PROVED** that anyone who **WANTS** an essential education **CAN HAVE** it. *You can, too!*

You Are Only **HALF** a Man Until Training Rounds Out Your Ability and Experience

To make your natural **ABILITY** pay you *profits*, and to get jobs that give you the *kind* of **EXPERIENCE** that promotes constant progress, you practically **MUST** back that *ability* with **TRAINING**... combine *experience* with **EDUCATION**. Using only a **PART** of your **SPARE** time, you can train **AT HOME** for the good position you want. If it is **WORTH** having, it **DEMANDS** training and is **WORTH** your effort!

Write for Facts No Obligation

Make up your mind to enjoy the **GOOD** things in life. Have **FAITH** in yourself, in your country and in your future. *Expect Success and get ready for it.* Write for **FREE** Bulletin **TODAY**. (See coupon.)



Gets Only the "Leavings"

With only grade school education, you are virtually **CONDEMNED** to the low pay, menial jobs that others **DON'T WANT**... because **THEY** are trained for better things. Home study can fit **YOU** too for more desirable, better paid positions.

Pays Up to \$16 a Week **EXTRA** Income

U. S. Bureau of Education figures prove that the average high school graduate earns \$16 a week more than grade school graduates.

You can complete our simplified High School Course in **SPARE** time at home, as **FAST** as time and ability permit. **MANY FINISH IN 2 YEARS**. Equivalent to resident school work—prepares for college, pre-professional examinations, business, industry. Standard texts. Diploma. Or if you've had some high school, **FINISH** now. Credit for subjects already completed. Single subjects if desired. Low tuition, easy terms. American School, Chicago, est. 1897—endorsed by educators.



Pays Up to \$25 a Week **EXTRA!**

Government figures show that graduates of specialized training of college grade average \$25 a week more than high school graduates, \$41 more than grade school graduates. But whether you failed to finish college—or failed to complete high school—home study **CAN HELP YOU**. Basic high school subjects are included in vocational courses listed below.

More than 150 noted educators, engineers and executives helped prepare American School courses. An **Advisory Board** of 20 outstanding authorities—each an active leader in his field—is consulted when our work is prepared or changed. A Staff of competent instructors—home study *specialists*—works closely with the individual student. Why continue in an underpaid, overworked job—subject to periodic layoffs? *Step up where you belong*, into well-paid, pleasant work where you command the admiration and respect of others. For full details, mail coupon **RIGHT NOW!**

American School, Dept. G 646, Drexel Ave. at 58th St., Chicago, Ill.

Gentlemen: Please send me **FREE** information covering special training in subjects checked below. No obligation on my part.

- | | |
|--|---|
| <input type="checkbox"/> Accounting and Auditing | <input type="checkbox"/> High School Course |
| <input type="checkbox"/> Architecture and Building | <input type="checkbox"/> Drafting and Design |
| <input type="checkbox"/> Automotive Engineering | <input type="checkbox"/> Liberal Arts |
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Private Secretary |
| <input type="checkbox"/> Aviation | <input type="checkbox"/> Mechanical Engineering |
| <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Radio and Television |
| <input type="checkbox"/> Elec. and Gas Refrigeration | <input type="checkbox"/> Salesmanship |
| <input type="checkbox"/> Air Conditioning | <input type="checkbox"/> Home Economics Courses |
| <input type="checkbox"/> Diesel Engineering | <input type="checkbox"/> Business Law |
| | <input type="checkbox"/> Retail Merchandising |

Name.....

Address.....

Spare Time Training Can Help You in Your Work—and Socially

Our Readers Say (CONTINUED)

dent of the Society of Automotive Engineers, at a meeting of that organization at White Sulphur Springs, W. Va. I note that he points out that the future will bring cars of entirely different basic design from those of today, as did your article in the June issue, "New Patents Forecast the 1942 Car." They will have engines in the rear, said Beecroft, as did your article. And he declared that they will have a superstructure integral with the chassis, as did your article. Both the speaker and your article pointed to evolutionary trends in car design, and predicted what the future car would be like if the trends continued. I would like very much to have heard Beecroft's talk, as I am intensely interested in the subject. At the same time, I doubt if I would have enjoyed it any more than I did your article. In telling what cars of the future will be like, the author of your article did a splendid job, basing his predictions on sound reasoning. Good stuff! Let's have more like it!—F. L., New York City.

The Ice Age Was a Myth, Declares This Reader

REPLYING to B. L. C., Trumansburg, N. Y., in regard to the Ice Age, will say that the Ice Age is only a myth. If not, why do we find the skeletons of animals, also the bodies of perfectly preserved mastodons and other

THAT WAS THE ICE AGE, NO MATTER HOW IT HAPPENED!



creatures that once lived in a hot country? At one time there were continents in both the Pacific and Atlantic oceans, which were sunk by an earthquake so terrific that it caused a tidal wave that swept over what is now known as Manchuria, carrying everything north in its path. Buried cities are found in that country to this

day. When the water receded, it brought down the ice over both hemispheres, destroying nearly everything, preserving some things. All this was many centuries ago, some estimate it as far back as 70,000 years. —W. L. G., Oakland, Calif.

There's No Use Trying It, Even in Modern Warfare

YOUR recent article on coast-defense guns reminds me of a rather priceless comment once made by Admiral William D. Leahy, then Chief of Naval Operations, U. S. N., before a Congressional committee. Here is the official record of the testimony: "Senator Gerry: It is an old, established naval policy, is it not, that you cannot attack successfully land fortifications with even capital ships if

these land fortifications are modern and in proper condition? Admiral Leahy: I think it would require a very dire necessity to induce any naval commander to take his fleet under the fire of modern shore batteries. Senator Gerry: Because the advantage is entirely with the shore battery, is it not? Admiral Leahy: The shore battery has one very decided advantage. It does not sink when it gets hit with a shell." I think that rates the Admiral as something of a wit.—B. T., Newark, N. J.

Father Burned His Fingers When He Bought That One!

THE curious, self-destructive pepper shaker that A. D. N., of Vancouver, B. C., writes about, reminds me of what happened once when I was a small boy, before electric lights. In those days, a good lamp chimney was an important matter. Father bought one that was supposed to be shock and heat-proof. To show it could take it, the dealer threw it over his head, and it fell to the floor without breaking. We used it for several weeks, when one night, as usual, Father blew out the light and went to bed. After the chimney had time to get thoroughly cooled, we all heard a loud explosion, similar to a pistol shot. We found the lamp chimney blown into hundreds of tiny pieces, and scattered all over the room. Maybe some reliable glass factory can explain it. At the time, we found no one who could.—A. H. B., Los Angeles, Calif.

THE "GOOD OLD DAYS"



And the People of Florida Might Like To Keep Their Gulf Stream

H. I. C.'s idea about pumping Gulf Stream water to the antarctic is a pretty impractical one, I think. In the first place, it would be virtually impossible to lay a pipe line that far, not to mention the cost of keeping the pipe in condition. In the second place, the cost of pumping would be terrific. And in the third place, why not pump the Gulf Stream water to New England where we wouldn't have to travel several thousand miles to take advantage of it, if he's so stuck on pumping it?—J. G. G., Gainesville, Fla.

WE COULD FORGET THE IDEA!





The ships that NEVER came in!

SOMEWHERE in the Ocean of Opportunity, there's a Sargasso sea of lost ships.

They were launched with laughter and hope, and the expectation of rich cargoes.

But they never came in. Sometime during their voyage, the winds of Ambition died down . . . and they drifted, canvas in tatters and hulls rotting.

Where's *your* ship?

One hundred thousand ambitious, determined men are enrolled *today* with the International Correspondence Schools.

They've plotted their own courses. Their hands are firm at the helm of their own destinies. They know that hope isn't enough. . . .

And they're getting the sound, practical *training* that will help them to succeed!

Here's the coupon they mailed!

INTERNATIONAL CORRESPONDENCE SCHOOLS

BOX 7697-J, SCRANTON, PENNA.



Without cost or obligation, please send me a copy of your booklet, "Who Wins and Why," and full particulars about the course *before* which I have marked X:



TECHNICAL AND INDUSTRIAL COURSES

- | | | | | | |
|---|---------------------------------------|---|--|--|--|
| <input type="checkbox"/> Agriculture | <input type="checkbox"/> Air Brake | <input type="checkbox"/> Cotton Manufacturing | <input type="checkbox"/> Manufacture of Pulp Paper | <input type="checkbox"/> R. R. Signalmen's | <input type="checkbox"/> Refrigeration |
| <input type="checkbox"/> Air Conditioning | | <input type="checkbox"/> Diesel Engines | <input type="checkbox"/> Marine Engines | <input type="checkbox"/> Sanitary Engineering | |
| <input type="checkbox"/> Architectural Drafting | | <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Mechanical Drafting | <input type="checkbox"/> Sheet Metal Work | |
| <input type="checkbox"/> Architecture | | <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Mechanical Engineering | <input type="checkbox"/> Steam Electric | |
| <input type="checkbox"/> Auto Engine Tune-up | | <input type="checkbox"/> Fire Bosses | <input type="checkbox"/> Mine Foreman | <input type="checkbox"/> Steam Engines | |
| <input type="checkbox"/> Auto Technician | | <input type="checkbox"/> Foundry Practice | <input type="checkbox"/> Navigation | <input type="checkbox"/> Steam Fitting | |
| <input type="checkbox"/> Aviation | <input type="checkbox"/> Boilermaking | <input type="checkbox"/> Fruit Growing | <input type="checkbox"/> Patternmaking | <input type="checkbox"/> Structural Drafting | |
| <input type="checkbox"/> Bridge Engineering | | <input type="checkbox"/> Heating | <input type="checkbox"/> Pharmacy | <input type="checkbox"/> Structural Engineering | |
| <input type="checkbox"/> Building Estimating | | <input type="checkbox"/> Heat Treatment of Metals | <input type="checkbox"/> Plumbing | <input type="checkbox"/> Surveying and Mapping | |
| <input type="checkbox"/> Chemistry | | <input type="checkbox"/> Highway Engineering | <input type="checkbox"/> Poultry Farming | <input type="checkbox"/> Telegraph Engineering | |
| <input type="checkbox"/> Civil Engineering | | <input type="checkbox"/> House Planning | <input type="checkbox"/> Practical Telephony | <input type="checkbox"/> Textile Designing | |
| <input type="checkbox"/> Coal Mining | | <input type="checkbox"/> Locomotive Engineer | <input type="checkbox"/> Public Works Engineering | <input type="checkbox"/> Toolmaking | |
| <input type="checkbox"/> Concrete Engineering | | <input type="checkbox"/> Machinist | <input type="checkbox"/> Radio, General | <input type="checkbox"/> Welding, Electric and Gas | |
| <input type="checkbox"/> Contracting and Building | | <input type="checkbox"/> Management of Inventions | <input type="checkbox"/> Radio Operating | <input type="checkbox"/> Woolen Manufacturing | |
| | | <input type="checkbox"/> Managing Men at Work | <input type="checkbox"/> Radio Servicing | | |
| | | | <input type="checkbox"/> R. R. Section Foreman | | |

BUSINESS COURSES

- | | | | | | |
|--|--------------------------------------|--|---|---|--------------------------------------|
| <input type="checkbox"/> Accounting | <input type="checkbox"/> Advertising | <input type="checkbox"/> Civil Service | <input type="checkbox"/> First Year College | <input type="checkbox"/> Railway Postal Clerk | |
| <input type="checkbox"/> Bookkeeping | | <input type="checkbox"/> College Preparatory | <input type="checkbox"/> Foremanship | <input type="checkbox"/> Salesmanship | <input type="checkbox"/> Secretarial |
| <input type="checkbox"/> Business Correspondence | | <input type="checkbox"/> Commercial | <input type="checkbox"/> French | <input type="checkbox"/> Service Station Salesmanship | |
| <input type="checkbox"/> Business Management | | <input type="checkbox"/> Cost Accounting | <input type="checkbox"/> Grade School | <input type="checkbox"/> Sign Lettering | <input type="checkbox"/> Spanish |
| <input type="checkbox"/> Cartooning | | <input type="checkbox"/> C. P. Accounting | <input type="checkbox"/> High School | <input type="checkbox"/> Traffic Management | |
| | | | <input type="checkbox"/> Illustrating | | |
| | | | <input type="checkbox"/> Lettering Show Cards | | |

DOMESTIC SCIENCE COURSES

- | | | |
|---|---|---|
| <input type="checkbox"/> Advanced Dressmaking | <input type="checkbox"/> Home Dressmaking | <input type="checkbox"/> Tea Room and Cafeteria |
| <input type="checkbox"/> Foods and Cookery | <input type="checkbox"/> Professional Dressmaking and Designing | Management, Catering |

Name.....Age.....Address.....

City.....State.....Present Position.....

Canadian residents send coupon to International Correspondence Schools Canadian, Limited, Montreal, Canada
British residents send coupon to I. C. S., 71 Kingsway, London, W. C. 2, England.

With the Inventors

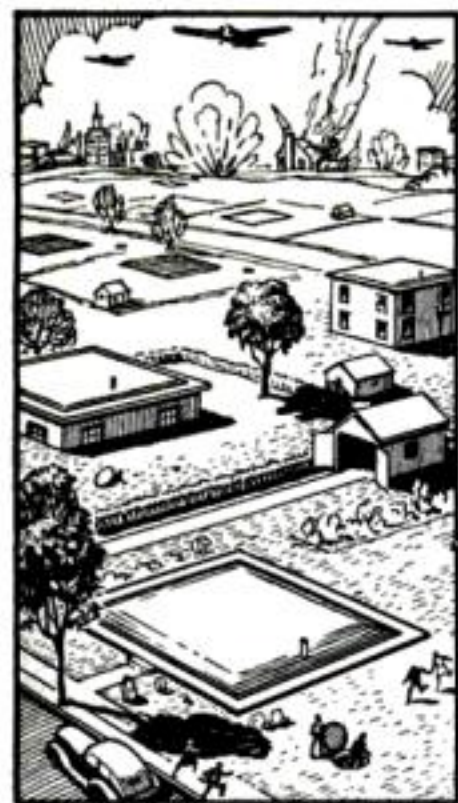
WHAT are the greatest American inventions? A committee of seventy-five scientists and industrial leaders recently examined eighty outstanding American



inventions and selected nineteen for the roll of honor. Try making your own list before you read the roster that follows: Eli Whitney's cotton gin; Robert Fulton's steamboat; Cyrus Hall McCormick's reaper; Samuel F. B. Morse's telegraph; Charles Goodyear's rubber vulcanization process; Elias Howe's sewing machine;

Christopher L. Sholes's typewriter; George Westinghouse's air brake; Alexander Graham Bell's telephone; Thomas A. Edison's phonograph, incandescent lamp, and motion-picture projector; Nikola Tesla's induction motor; Charles M. Hall's aluminum process; Ottmar Mergenthaler's linotype machine; Wilbur and Orville Wright's airplane; Lee De Forest's three-electrode vacuum tube; Leo Baekeland's synthetic plastics; and William M. Burton's oil-crack-

ing process. And suppose you had to select the three greatest inventions from this list of nineteen—send a note and let us know which trio you would choose . . . FOR PROTECTION AGAINST the ravages of dust storms, hurricanes, tornadoes, and bombs dropped from the skies, Andre D'Amico, of Rochester, N. Y., suggests homes that can be made



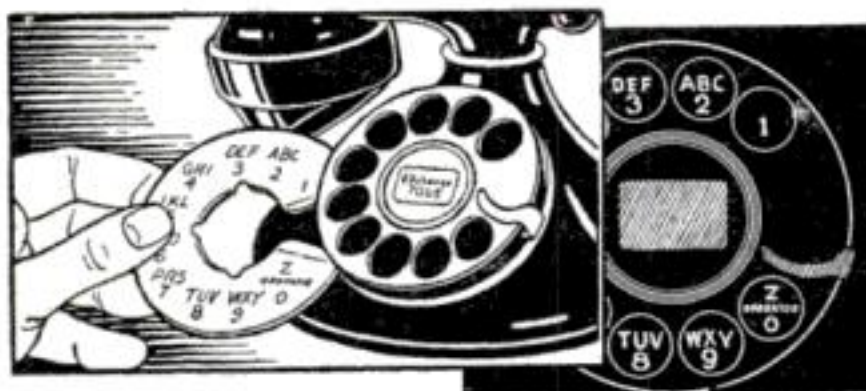
to disappear into the ground. Built over a pit dug in the earth, the two-story structures are lowered into the hole by means of a hydraulically operated plunger so that their

reinforced metal roofs are flush with the ground level. Movable bolts attached to the houses rest on a ground-level ledge to support the structures

when in their normal raised positions . . . HARDLY A SINGLE WEEK passes without the issuance of at least one patent for some new kind of a coat or garment hanger . . . IF A DRIVING rainstorm comes up during the night, you'll find your windows will close automatically if they are equipped with a device worked out by Peter Pusak, of Eddystone, Pa.



Wires attached to the window sash are fastened to a spring-operated roller mounted on the sill. When the window is open a strip of special paper holds the roller against the action of its spring, but when rain or fire causes the paper strip to break, the roller is free to draw the open window down to a closed position . . . WHAT ARE BELIEVED to have been the first patents ever issued in the world were granted by the ancient Greeks to their chefs, to encourage the invention of new palate-tickling food concoctions. Wonder who got the first patent on hash . . . WITHOUT CHANGING or removing any telephone parts, an attachment developed by George I. Dormont, of



Los Angeles, Calif., provides luminous numerals to make it easy to dial numbers in the dark, or in phones located in badly lighted corners or booths. Made of metal, plastic, or heavy paper in a dark color, the attachment consists of a flat ring that fits in

(Continued on page 18)

For Quick Action

SEND TODAY



INVENTORS

**MAIL COUPON NOW
TO CLARENCE A. O'BRIEN**

Registered Patent Attorney
BEFORE U. S. PATENT OFFICE

Clarence A. O'Brien, Adams Building, Dept., OJ2, Washington, D. C.
Please send me your Free 48-Page "Patent Guide" and your specially prepared "Record of Invention" form. This request does not obligate me.

Name

Address

City

(Please write or print plainly)

State

Get Free 48-PAGE BOOK

on How to Obtain PATENT and Market Inventions

If you have invented something, if you are interested in inventing something, you need our new 48-page book that gives the entire Story of Patents. It tells you for the first time about new phases of invention, how others succeeded, how the patent laws protect you, how to market your invention, where to obtain finances, how to form a company, partnership, or arrange for royalties from your invention's sale.

Be Sure To Protect Your Rights

The U. S. A. is the greatest open market for new inventions in the world. Here commercial striving is so keen that the unprotected invention, if it has public acceptance, is quickly "eyed" and may become the prey of eager competition. Worthwhile manufacturers will not bear the production costs and sales expense of promoting a new invention unprotected by patent. A good, strong patent not only opens the road to marketing your invention but closes it to would-be chiselers who may seek to reap the rewards of your creative efforts.

Free Form For Recording Invention

When you send for our FREE Patent Guide, we include, also Free, our specially prepared Record of Invention blank, on which you can quickly make and date a sketch and description of your invention. This "disclosure" as it

is called, may be absolutely invaluable as evidence for you, should your rights ever be contested. Be sure to get it and use it.

Let Us Help You With Your Patent

During the past twenty years we have helped great numbers of inventors secure their U. S. Patents. We know the pitfalls and how to avoid them. We have trained, experienced patent draftsmen and registered patent attorneys ready to serve you—and each one, when he undertakes to handle your case, realizes that he is personally responsible to contribute the fullest individual effort possible.

Get Free Book—Mail Coupon Now

Know exactly what you should do to secure a Patent—what must be done every step of the way—how the Patent Law protects you—what we, as Registered Patent Attorneys, can do for you. Mail the above coupon NOW for our 48-page Patent Guide and Record of Invention Form.



CLARENCE A. O'BRIEN

REGISTERED PATENT ATTORNEY before U. S. PATENT OFFICE

ADAMS BUILDING, DEPT. OJ2, WASHINGTON, D. C.

DON'T FORGET THIS:
A little idea may have
big money-making
possibilities!

PATENT and SELL your INVENTION



Act now!
U. S. Patent Laws
favor the first to act.
Delay may be costly.
Write us today.

Business today is eager for practical, new manufacturing ideas. Opportunity for men with inventive talent was never greater than it is right now. If you have an idea for a new device—no matter how simple it may be—or for the improvement of an article now in use, find out **AT ONCE** how you can protect your rights to it and proceed to commercialize it. These two advisory books offered you without cost, may prove invaluable to you. Send for them **NOW**.

68 PAGES OF FACTS FOR INVENTORS

Plainly written, easily understood. Tell you how to apply for patent protection; give six basic methods of selling your invention. Get them **TODAY**.



42 years of helpful
service to inventors

VICTOR J. EVANS & Co.

One of World's Largest Firms of Registered Patent Attorneys

MAIN OFFICE: 570-K VICTOR BLDG., WASHINGTON, D. C.
Pittsburgh Office: 514-C Empire Bldg.

Please send me immediately without charge or obligation, your two advisory books and your "Evidence of Invention" form.

Name.....

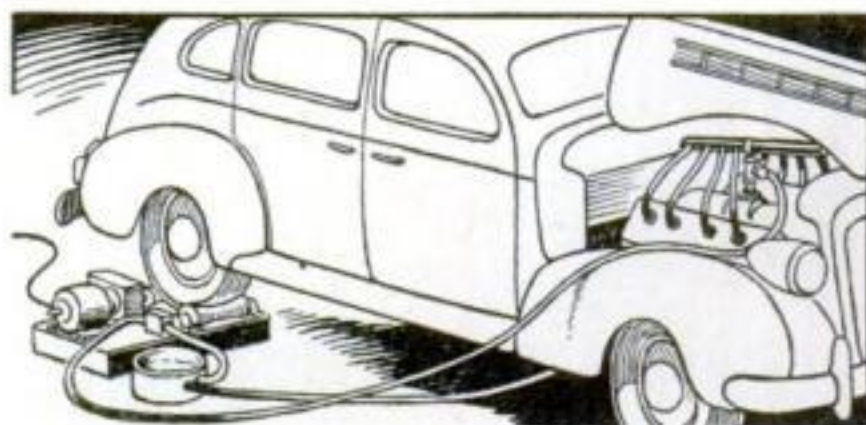
Address.....

City State.....

With the Inventors

(Continued from page 16)

place over the standard ring bearing letters and numerals. The accessory duplicates the marking of the original, but with some such luminous material as phosphorescent paint or a radium-salt composition . . . THE REGISTRATION OF commercial prints and labels has been transferred from the juris-



diction of the Commissioner of Patents to that of the Register of Copyrights in the Library of Congress . . . **AN EASIER METHOD OF REMOVING** carbon from an automobile engine than the common practice of removing the cylinder head and scraping or burning carbon from the affected parts, is outlined in the specifications for an apparatus credited to George Hofele, of St. Louis, Mo. Rollers turned by an electric motor drive the rear wheel of a car, and since the engine is left in gear, the pistons are set in motion. A pump forces a special liquid through a tube into a manifold which distributes the carbon-dissolving fluid to all cylinders through spark-plug and carburetor openings. The exhaust manifold of the engine is blocked to prevent the liquid from being discharged during the cleaning process . . . **DRAWINGS IN PUBLISHED PATENTS** for new plants appear in full color . . . **NO SCREWS, NAILS,** or other type of permanent attachment is needed to hold in place novel brackets designed by James H. York, of Cincinnati, Ohio, to support both a window shade and curtains. Made of metal, the brackets are provided with separate notched



(Continued on page 20)

Practical Facts You Will Want to Know About

PATENTS TRADE MARKS COPYRIGHTS

INVENTORS! If you are working on a new device or idea—send for our free booklets. They contain practical information based on 65 years' experience as patent attorneys. These books will tell you how to protect your invention, explain the necessary steps in patent procedure and describe the various opportunities for capitalizing on your invention. All inquiries confidential and answered immediately. Write for free books today.

• **C. A. SNOW & CO.**
Registered Patent Attorneys Since 1875
209 Snow Building Washington, D. C.

PATENTS PERSONAL SERVICE

My Personal service assures strictest confidence on all your patent problems. Send me a model or drawing, or

sketch and description of your invention, and \$5.00. I will make a search and report promptly as to its patentability and send you a copy of my 72-page booklet. Or, if you prefer to read my booklet first, write today for **FREE** copy. Registered Patent Attorney.

L. F. Randolph, 340-D Victor Bldg., Washington, D.C.

Inventions Wanted Patented or Unpatented

We have been successfully selling inventions, patented and unpatented, since 1924. Write us, if you have a practical, useful idea for sale.

Chartered Institute of American Inventors
Dept. 3, Barrister Building Washington, D. C.

PATENTS—TRADE MARKS

All cases submitted given personal attention. Form "Evidence of Conception" with instructions for use and "Schedule of Government and Attorneys' Fees"—**FREE!**

LANCASTER, ALLWINE & ROMMEL
(Patent Law Offices)

413 Bowen Bldg. Washington, D. C.

Inventions Promoted

Patented or Unpatented. In business over 30 years. Send drawing and description or model, or write for information. Complete facilities. References.

ADAM FISHER COMPANY

183-D Enright, St. Louis, Mo.

Correspondence Courses in **RADIO and ELECTRICAL ENGINEERING** **LOW AS \$25**

ELECTRICAL ENGINEERING. Get good grasp of wide electrical field. Modern. Very understandable. Theory made easy.
RADIO ENGINEERING. Extra fine course in radio, public address, photo-electric work. Trains you to be super-service man, real vacuum tube technician. Tuition **ONLY \$25**, either course. Deferred payment plan. Experiment kits furnished.
FREE Write for free copies of school catalogs, student magazines, etc.
LINCOLN ENGINEERING SCHOOL, Box 931-S-21, Lincoln, Nebr.

BARGAINS!!! Used Home-Study Courses BOUGHT-SOLD-RENTED

72-PAGE
ILLUSTRATED
CATALOG
FREE

Write today for big **FREE** illustrated catalog explaining this amazing service. Used correspondence courses and educational books on every subject. 100% satisfaction guaranteed. **We buy for cash**—we offer unbelievable bargains. Send your name on penny postcard at once! No obligation.

NELSON COMPANY
500 Sherman, Dept. J201, Chicago

Be a Radio Technician



**Learn at Home to Make
\$30, \$40, \$50 a WEEK**



**Chief Operator
Broadcasting Station**

Before I completed 20 lessons, I obtained my Radio Broadcast Operator's license and immediately joined Station WMPC where I am now Chief Operator.—**HOLLIS F. HAYES, 327 Madison St., Lapeer, Michigan.**

**\$200 to \$300
a Month in
Own Business**

For the last two years I have been in business for myself making between \$200 to \$300 a month. Business has steadily increased. I have N. R. I. to thank for my start in this field.—**ARLIE J. FROEHNER, 300 W. Texas Ave., Goose Creek, Texas.**



**\$15 a Week
Extra in
Spare Time**

I am doing spare time Radio work, and I am averaging from \$700 to \$850 a year. Those extra dollars mean so much—the difference between just barely getting by and living comfortably.—**JOHN WASHKO, 97 New Crosby, Hazelton, Penna.**

Radio broadcasting stations employ Radio Technicians as engineers, operators, maintenance men. Radio manufacturers employ testers, inspectors, foremen, servicemen in good-pay jobs. Radio jobbers and dealers employ installation and servicemen. Many Radio Technicians open their own Radio sales and repair businesses and make \$30, \$40, \$50 a week. Others hold their regular jobs and make \$5 to \$10 a week fixing Radios in spare time. Automobile, police, aviation, commercial Radio loudspeaker systems, electronic devices are other fields offering opportunities for which N. R. I. gives the required knowledge of Radio. Television promises to open good jobs soon.

Many Make \$5 to \$10 a Week Extra in Spare Time While Learning

The day you enroll, in addition to my regular Course, I start sending you Extra Money Job Sheets—start showing you how to do Radio repair jobs. Throughout your course I send plans and directions which have helped many make \$5 to \$10 a week in spare time while learning. I send special Radio equipment to conduct experiments and build circuits. This 50-50 training method makes learning at home interesting, fascinating, practical. I also give you a **MODERN PROFESSIONAL ALL-WAVE, ALL-PURPOSE SET SERVICING INSTRUMENT** to help you make money fixing Radios while learning and equip you for full time work after you graduate.

**Find Out What Radio and
Television Offer You**

Act Today! Mail the coupon for my 64-page Book, "Rich Rewards in Radio." It points out Radio's spare time and full time opportunities and those coming in Television; tells about my Course in Radio and Television; shows more than 100 letters from men I have trained, telling what they are doing and earning. Read my money back agreement. **MAIL COUPON** in an envelope, or paste on a penny postcard.

**J. E. SMITH, President, Dept. OJP3
National Radio Institute, Washington, D. C.**

**Mail this Now FREE
Get 64-page Book**

**J. E. Smith, President, Dept. OJP3
National Radio Institute
Washington, D. C.**

Mail me **FREE** without obligation, your 64-page book "Rich Rewards in Radio" which points out Radio's opportunities and tells how you train men at home to be Radio Technicians. (No salesman will call. Write Plainly.)

AGE.....

NAME

ADDRESS

CITY.....STATE.....



AVIATION Wants More LINCOLN TRAINED MEN

ADVANCE EMPLOYMENT ORDERS NOW EXCEEDING OUR AVAILABLE GRADUATES. Airlines, Airplane Factories, Aviation Operators are calling on this **LINCOLN GOVERNMENT APPROVED SCHOOL** for more trained men. Airlines calling for advanced trained Pilots. Training centers calling on us for Flight Instructors.

A TOP RANKING U. S. SCHOOL

Lincoln's Primary and Advanced Flight Training. Government Approved, prepares for Gov't. Ratings and responsible flying positions. Large fleet of Training Planes. **TRAIN FOR AN AIRLINE MECHANICS POSITION** Government Approved Training prepares for Gov't. Ratings and immediate employment as Airline Maintenance Mechanic. Short term courses prepare for job in Airplane Factory. **BE AN AERONAUTICAL ENGINEER.** Learn to design and build airplanes. Our students getting actual experience. Big demand for Engineers.

NOW IS THE TIME TO TRAIN for Aviation! Opportunities the best they've ever been. Good Pay! Rapid advancement. Our Placement Department assisting Graduates into fine positions. Now offering part-time employment for board and room while in training. Act quickly.

MAIL COUPON NOW for information.

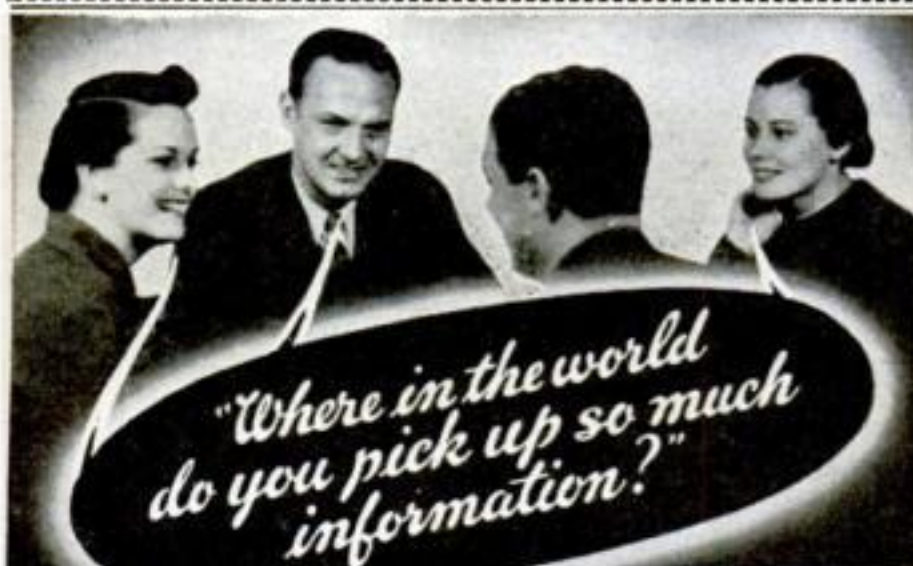


LINCOLN AERONAUTICAL INSTITUTE, (INC.)
LINCOLN AIRPLANE & FLYING SCHOOL DIVISION
629 Aircraft Building, Lincoln, Nebraska
I'd like to get ready for a job in Aviation as soon as I can. Please rush complete information about Lincoln Training.

NAME AGE

ADDRESS

CITY STATE

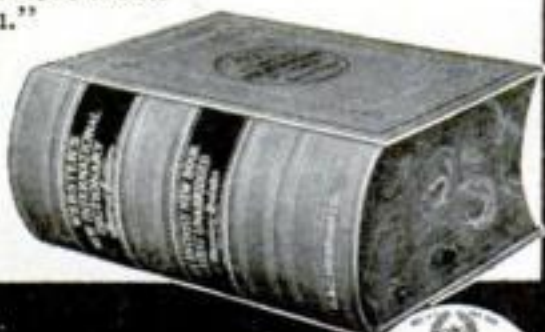


HIS secret is simple. For years he has had "the MERRIAM-WEBSTER habit"—has looked up every subject that interested him in this "Supreme Authority." It contains 600,000 entries—122,000 more than in any other dictionary. Your bookdealer will be glad to show it. Write for free booklet: "The New Merriam-Webster: What It Will Do For You."

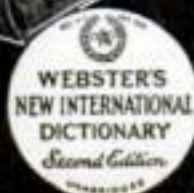
G. & C. Merriam Co., Dept. 503, Springfield, Mass.

Look for the circular trade-mark

Copyright, 1939, by G. & C. Merriam Co.



*Webster's
New International
Dictionary*



Second Edition

With the Inventors

(Continued from page 18)

extensions that hold a shade next to the window and a curtain rod a short distance out from it. One end of the bracket rests flat against the wall near the top of the window, while a curved arm, toothed at one end,



bends up and around the molding above the window to anchor the accessory in place . . . THE COMPLEXITY OF the job of classifying U. S. patents is indicated by the partial definition of one subclass in the Patent Office: "Mechanisms for releasing or tripping portions of machines to cause other portions to automatically operate." . . . A MULTIPLE CANDLE, constructed in various patterns that give it a number of wicks, is the work of Cameron Turner, of Beverly, Mass. The birthday-cake type shown in the illustration starts out with flames burning from each of ten wicks. As the paraffin melts and candle height decreases, Twenty flames will be burning as each candle branch divides into two. Later, the flames will decrease to ten, and then increase to twenty once more. The curious and novel candles may be made in a large number of decorative designs . . . TO BE PATENTABLE, an invention must operate as described, but it need not be perfect . . .

A WEAPON THAT recommends itself for police use is a combination blackjack and a one-shot gun. Equipped with a built-in, spring-operated firing pin, the weapon is loaded by removing the barrel and inserting a cartridge. A thumb-operated trigger fires the gun, and a safety mechanism prevents accidental discharge when it is used as a club. Jesse M. Bohler, of Atlanta, Ga., is the inventor.



CAREERS IN ELECTRICITY

Become a Bliss technician in one year—ready to take advantage of opportunities in the electrical field. Bliss men, today, fill key positions in many electrical industries. All received the same course in fundamental theory and practice.

Comprehensive training; skilled instructors give personal guidance. Modern shops and laboratories. Highly successful placement record. Spacious campus. 48th year. Ask for free vocational chart. 109 Takoma Ave., Washingt'n, D.C.

BLISS ELECTRICAL SCHOOL

Your Place in Aviation... SPARTAN SCHOOL OF AERONAUTICS



Come to SPARTAN for today's finest expert training for your choice of aviation careers—Flying, Engineering, Mechanics, Radio, Approved by U. S. Civil Aeronautics Authority. 15 modern airplanes, latest aircraft engines; completely equipped shops, laboratories—private practice fields; 17 modern buildings; club-like dormitories. \$100,000 expansion program making SPARTAN even greater. New semester starts Sept. 30th. Write for free catalog. CAPTAIN MAXWELL W. BALFOUR, Director Dept. PS-90 Tulsa, Oklahoma

EARN A DEGREE AT HOME

From A Chartered Institution of Higher Learning Employers Now Demand College Graduates With Degrees

88 Degree Courses in Arts; Sciences; Philosophy; Education; Public Health; Medical Jurisprudence; Psychology; Sociology; Physics; Chemistry; Geology; Pol. Science; Theology; Law; Business Training; Accounting; Statistics; Agriculture; Electrical, Civil, Mechanical, Drafting, Architectural, Automotive, Steam, Diesel, Aeronautical, Radio, Structural, Industrial, Highway, Petroleum, Mining, Marine, Refrigeration, Air Conditioning, Chemical Engineering. Founded 1908. Chartered. McKinley-Roosevelt Graduate College, 4750-A Sheridan Road, Chicago

ENGINEERING DEGREE IN TWO YEARS

B. S. Degree courses in engineering: Electrical, Civil, Chem., Mechanical, Radio or Aeronautical. 1 yr. Mech. Drafting. Approved by Civil Aeronautics Authority, participation in Pilot Training Program. Large industrial center. Prep courses without extra charge. Earn board if desired. Low tuition. Enter Sept. 3, December, March, June. Write for Catalog.

690 E. Washington Blvd., Fort Wayne, Ind.

INDIANA TECHNICAL COLLEGE



TRI-STATE COLLEGE

B-S-Degree in 2 years

World famous for technical 2-year courses in Civil, Electrical, Mechanical, Chemical, Radio, Aeronautical Engineering, Business Administration and Accounting. Special preparatory department for those who lack required high school work. Short diploma courses (36 weeks) in Surveying, Drafting. Low tuition. Low living costs. Students from every state and many foreign countries. 57th year. Enter September, January, March, June. Write for catalog. Burton Handy, Pres., 590 College Ave., ANGOLA, INDIANA.

GET A DRAFTING JOB

Drafting Jobs Often Pay \$175.00-\$350.00 month. Trained draftsmen always in demand. Learn drafting at home in spare time. Experience unnecessary. Common education enough. Employment service FREE. Write today for complete information. No obligation. No salesmen. MONROE INSTITUTE, Dept. B-109, Alton, Illinois



ARE YOU A STRANGER- To Yourself?

Do you know what you are best fitted for? Can you interpret your moods—know the mental influences—behind your whims and fancies? Let the Rosicrucians (not a religious organization) show you how to discover yourself and master your life. Send for the free "Sealed Book" that tells how to receive these facts. Address Scribe B. M. R.

The ROSICRUCIANS

SAN JOSE (AMORC) CALIFORNIA

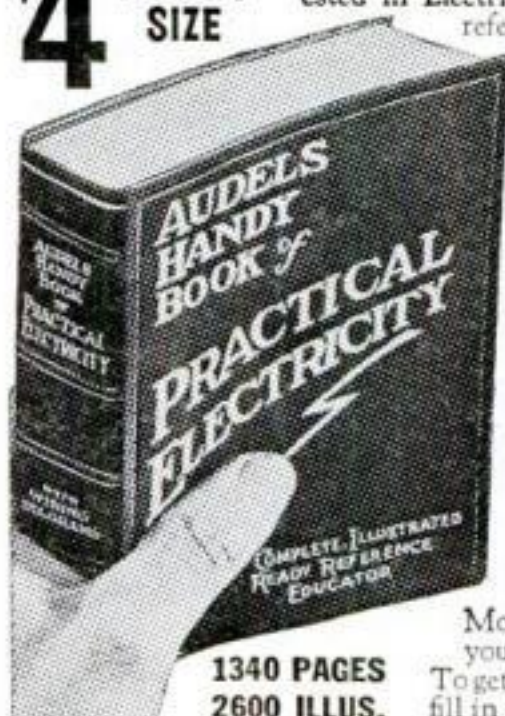
KEY TO A PRACTICAL UNDERSTANDING OF ELECTRICITY

\$1 PER MO.

• AUDELS HANDY BOOK OF ELECTRICITY

\$4 HANDY SIZE

For Engineers, Electricians, Students and all interested in Electricity. A quick, simplified, ready reference, giving complete instruction and practical information. Easy to understand. A reliable authority and a handy helper that answers your questions.



• INSIDE TRADE INFORMATION ON

The Rules and Laws of Electricity—Maintenance of Machinery—A. C. and D. C. Motors—Armature Winding and Repair—Wiring Diagrams—House Lighting—Power Wiring—Cable Splicing—Meters—Batteries—Transformers—Elevators—Electric Cranes—Railways—Bells—Sign Flashers—Telephone—Ignition—Radio Principles—Refrigeration—Air Conditioning—Oil Burners—Air Compressors—Welding, and many Modern Applications explained so you can understand.

1340 PAGES
2600 ILLUS.

To get this assistance for yourself, simply fill in and mail the FREE COUPON below.



READ FOR PROFIT!

THEO. AUDEL & CO., 49 West 23rd Street, New York
Please send me "Audels Handy Book of Practical Electricity" for free examination. If satisfactory, I will send you \$1 in 7 days, then \$1 monthly until \$4 is paid. Otherwise I will return it.

Name _____
Address _____
Occupation _____
Reference _____ PSM

RADIO-TELEVISION

Oldest, largest Radio-Television school in West trains you for good pay job. Complete instruction including Radio Construction and Service, Broadcast Operating, Sound, Talking Pictures, Television, Public Address, etc. Flexible plan to meet specific needs of those with or without jobs. Transportation allowed to L. A. Earn room and board while learning. Request Free Catalog.

NATIONAL SCHOOLS Dept. PSR-9 Los Angeles

INVENTORS PATENT YOUR IDEAS SEND FOR FREE BOOK

HOW TO OBTAIN A PATENT

Written by a Former Member of the Examining Corps (1922-24) of the U. S. Patent Office. If you want to profit by your idea, you should take steps to apply for a U. S. Patent at once. Your first step is to get this Free Book. This interesting illustrated book contains valuable information you should have. It tells you fully how to obtain a patent on your idea in the quickest way. With this Free Book you will also receive a "Record of Invention" form on which you can easily record your idea. Personal and Confidential Service: Your case will be personally handled only by a Registered Patent Attorney who is also a Former Member of the Examining Corps of the U. S. Patent Office. All communications confidential.

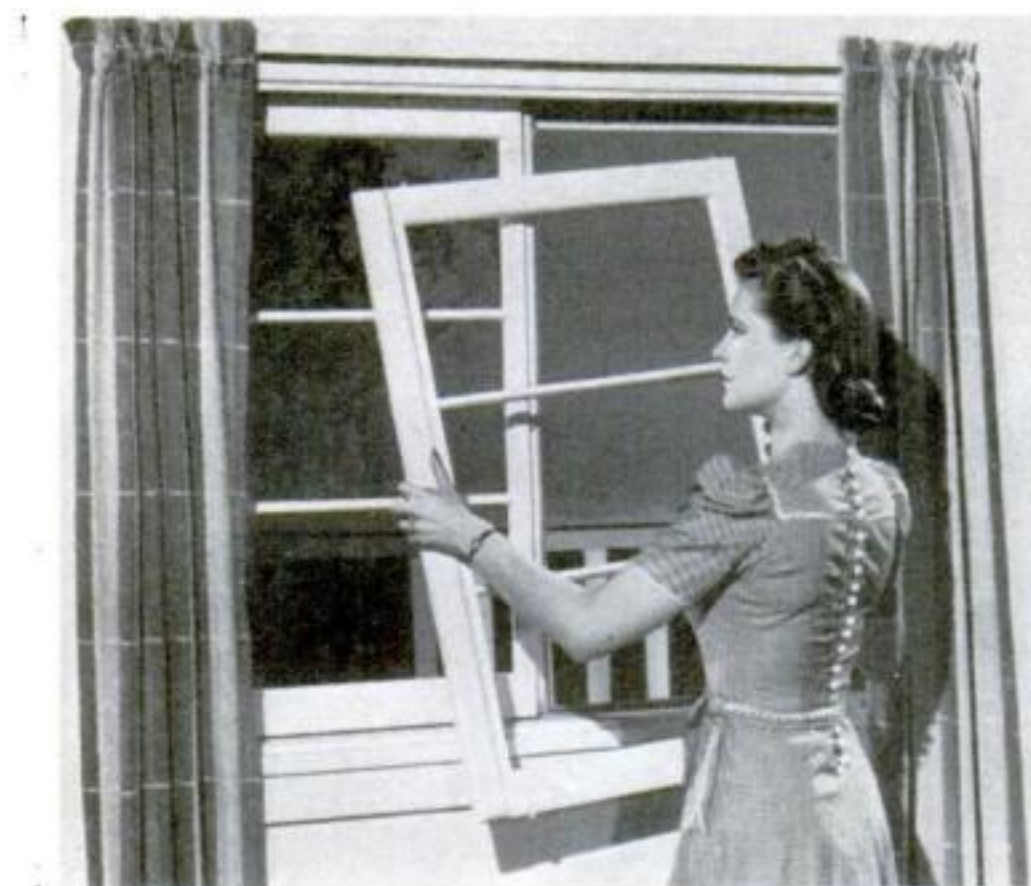
MAIL COUPON TODAY for FREE PATENT BOOK and RECORD OF INVENTION Form.

CARL MILLER
REGISTERED PATENT ATTORNEY
FORMER MEMBER EXAMINING CORPS U. S. PATENT OFFICE

Woolworth Bldg., 35th Floor, Dept. 90-C, New York City
MILLER BUILDING, Dept. 90-C, WASHINGTON, D. C.
Please send me your Free Book, "How to Obtain a Patent," and your "Record of Invention" form.

NAME _____
ADDRESS _____

Hints for Home Owners



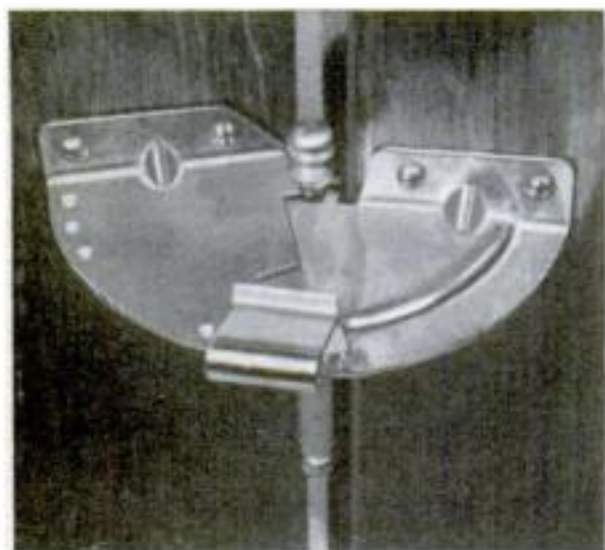
Windows slide on steel guides, as shown below. In the photograph at the left, one of the frames is being lifted out for washing



Windows Slide Horizontally and Are Easy To Take Out

SLIDING WINDOWS that resemble casement types when closed, and require no sash weights or hinges, are now on the market. Each sash slides horizontally on polished steel glides, guided by a head and sill track. Both sashes lie in the same plane when

closed, but one pulls inward and slides past the other to afford a single large opening. Sliding both sashes forms an opening at either side of the units, which may easily be removed for cleaning or installation of double glazing for winter use.

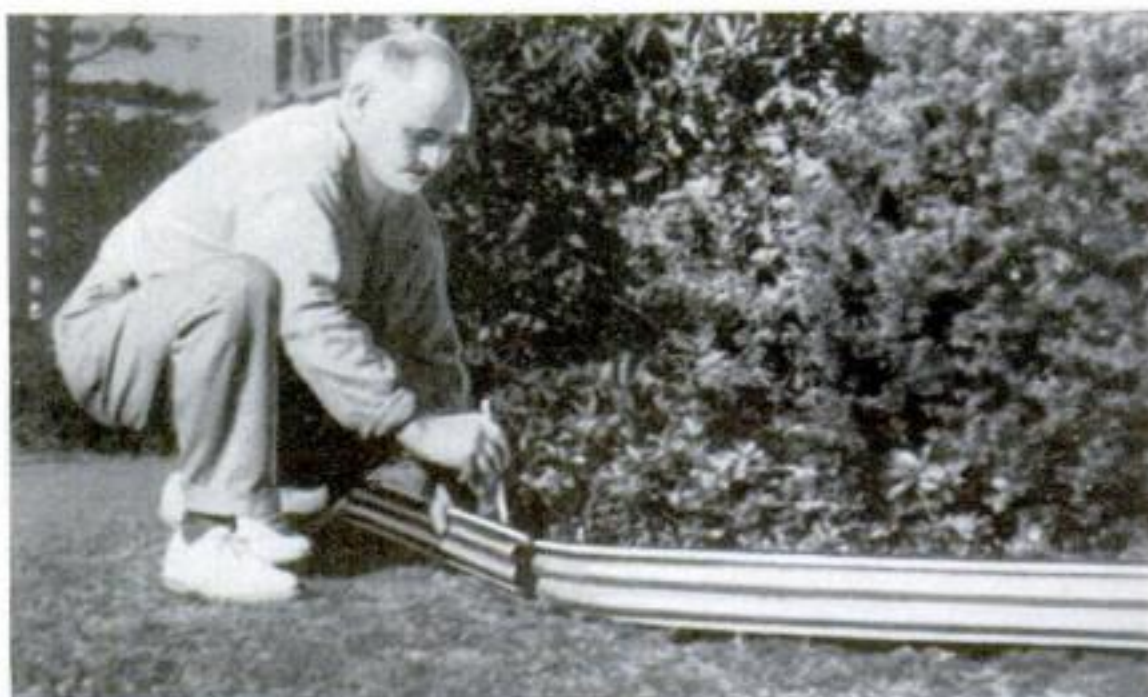


Holder Locks Door at Various Angles

DOORS may be held firmly in place at various angles by a new holder designed to be mounted on the door at the hinge. Made of steel plated with brass, the device will hold a door steady at five different angles under ordinary conditions, even when windows are open and a breeze is blowing.

Metal Edging Makes Neat Lawns

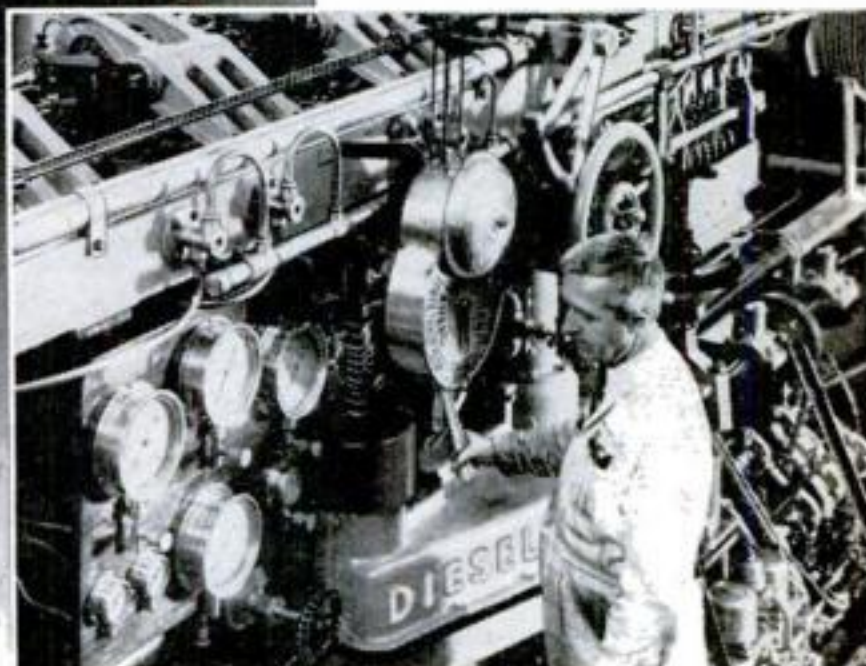
TO HELP give a neat appearance to driveways, walks, flower borders, and other features of a lawn, easily installed metal edging is now available. Made either of zinc alloy or galvanized steel, the material comes in interlocking strips that are driven into the ground and supported by metal reinforcing stakes.



Reinforcing stakes support the metal edging along lawn borders

THIS TAKES Training

AND SO DOES
THIS!



■ Training is important—whether you wish to be “tops” in skating or an expert in the Diesel field. It takes a lot of “know how” to repair, service, adjust and maintain modern Diesel engines—and they are being produced in greater numbers and varieties each year. Training is the shortcut to practical experience. Each year brings more and more activity in Diesel—but have you thought of yourself in connection with this great industry?

Send coupon for your free copy of “March of Diesel” and find out about it. Find out about Hemphill Diesel training. No matter where you live or what you are doing, you can start your training now, at home—and take your shop work later. Day or night resident school courses, also. Investigate—mail coupon today. No obligation.



HEMPHILL DIESEL SCHOOLS

Diesel courses in both English and Spanish for students in U. S. and Latin America. Write for information and terms.

SEND COUPON TODAY!

- Send coupon to the nearest Hemphill Diesel School:

New York . . . 31-32 Queens Blvd., L. I. City
Chicago 2006 Larrabee Street
Memphis 431 Monroe Avenue
Los Angeles 2012 San Fernando Rd.
Vancouver, B. C. . . . 1365 Granville St.

HEMPHILL DIESEL SCHOOLS

Please send my free copy of “March of Diesel” booklet and information on Hemphill Diesel training.

NAME _____ AGE _____
STREET _____
CITY _____ STATE _____ m-45-s

Do you want

→ ..to go to College?

→ ..or to enter a Profession?

(Such as Accounting, Architecture, Nursing, Dentistry, Teaching, Social Work, Osteopathy, Beauty Culture, Optometry, Embalming, Chiropractic, Law, Medicine, etc.)

→ ..or get an Office Position?

To get anywhere, you practically MUST finish High School FIRST. You can complete our simplified High School Course in SPARE time at home, as FAST as your time and abilities permit. Equivalent to resident school work—prepares you for college, pre-professional examinations, business, industry. Standard texts furnished. Diploma. Credit for H.S. subjects already completed. Single subjects if desired. Low tuition, easy terms. American School, Chicago, est. 1897—endorsed by educators. Finish your high school education NOW. Write TODAY!

High School Course at Home

Many Finish in 2 Years

American School, Dept. H-646, Drexel Ave. at 58th St., Chicago, Ill.

Gentlemen: Send me FREE information covering special training in subjects checked below. No obligation on my part.

- | | |
|--|---|
| <input type="checkbox"/> High School Course | <input type="checkbox"/> Diesel Engineering |
| <input type="checkbox"/> Accounting and Auditing | <input type="checkbox"/> Drafting and Design |
| <input type="checkbox"/> Architecture and Building | <input type="checkbox"/> Liberal Arts |
| <input type="checkbox"/> Automotive Engineering | <input type="checkbox"/> Private Secretary |
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Mechanical Engineering |
| <input type="checkbox"/> Aviation | <input type="checkbox"/> Radio and Television |
| <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Salesmanship |
| <input type="checkbox"/> Elec. and Gas Refrigeration | <input type="checkbox"/> Business Law |
| <input type="checkbox"/> Air Conditioning | <input type="checkbox"/> Retail Merchandising |

Name

Address

Learn to MOUNT BIRDS

Tan SKINS, Make Up FURS

Be a Taxidermist. We teach you at Home.

Mount Birds, Animals, Pets, common specimens. Save your hunting trophies; decorate home and den. Make genuine KROME LEATHER, tan and make up furs for sparetime profit.

FREE BOOK 48 pages—tells all about it.

Hunters, get this wonderful book. Its Now Free. Send postal card Today—This Minute! State your AGE.

N. W. School of Taxidermy, Dept. 3396, Omaha, Nebr.



SENSATIONAL! BURNER IMPROVEMENT MAKES OIL BURN Just Like CITY GAS!



3 MODELS FIT ALL STOVES



No Gasoline
No Explosive
Oils



Produces
HOT, CLEAN
(White-Heat)
FLAME

NOT like any oil burner you've ever seen. No noisy roar—no smoke—no soot—no clogged jets. DORTANE makes cheap oil burn as clean and hot as city gas, at one-third to one-half the cost. Slips into any range, stove or heater—attached in few minutes—operated efficiently by anyone.

ALL THESE PROSPECTS

Will heat stoves, ranges, urns, steam tables, grills, vulcanizers, water coils, ovens, griddles, pressing machines, tanks, etc.

WIDE OPEN FOR DISTRIBUTORS AND AGENTS

A sensational seller to homes and business men on time-pay plan or open account. BIG PROFITS for CITY DISTRIBUTORS and agents in rural communities.

FREE Don't lose a minute. All facts are FREE. Rush your name quickest way for book showing and describing all models Liberty Burners. No money. Just your name and address.

LIBERTY BURNER CO.

Dept. A139, 620 N. Michigan Ave., Chicago, Ill.

Hidden Screen Unrolls When Window Is Open



Screens come into place as windows are opened

THROW UP the sash of a novel reversible-type window invented by Jack Stangler, of New York City, and a screen automatically appears in the opening. Screening is mounted on concealed rollers and is pulled into place by the action of raising the bottom sash or lowering the top. By this means, screening does not cut down light entering the window when it is closed. The sash can be made of metal, wood, or plastics.

Paint Brushes Cleaned by Dipping in Solvent

PAINT BRUSHES are easily cleaned after use, without soaking in water or oils, by dipping them in a new solvent that quickly dissolves the paint on the bristles, and emulsifies it so that the pigments and oils can be rinsed away instantly under a water tap. The solvent is said to have no harmful effect on bristles.

Smell Killer for Paint

NO UNPLEASANT and annoying odor of paint will cling to rooms recently painted if a small amount of a new chemical compound is added to the paint before use.



Adding chemical to prevent that fresh-paint odor

PARKS AIR COLLEGE

PARKS AIRPORT EAST ST. LOUIS, ILL.

Offers YOU COLLEGE and PROFESSIONAL TRAINING Majoring in AVIATION

Accredited by the Illinois Superintendent of Public Instruction, U.S. approved as a Commercial Ground and Flying School and Mechanics' School. Accredited by and cooperating with the United States Army Air Corps in giving flight and mechanical training. Open to high school graduates.

FOUR courses lead to B.S. degrees in Professional Piloting, Aviation Operations, Maintenance Engineering, Aeronautical Engineering.

EIGHTEEN TRAINING PLANES are used in professional flight training which prepares graduates for airline flight operations. 76,000 hours flight training given. 1800 hours being flown monthly. FACULTY of 46 specialists in various fields of aviation.

1569 graduates. Enrollment limited to a total of 300 commercial aviation students. Total enrollment 415.

100-acre airport, 22 buildings devoted to school purposes exclusively. Dormitories and dining hall at the College.

Fall Term September 30. Send postcard for new 64-page catalog.

14th YEAR REGISTRAR, DEPT. PS-9
PARKS AIR COLLEGE, East St. Louis, Ill.

You Can Train To Be an ARTIST

Trained Artists Are Capable of Earning \$30, \$50, \$75 Weekly. Many of our graduates are now enjoying successful Art careers. Our practical method makes it fun to learn Commercial Art, Cartooning and Designing AT HOME IN YOUR SPARE TIME. Write for details in FREE BOOK, "Art for Pleasure and Profit", explains course and opportunities. Describes TWO ARTISTS' OUTFITS included with training. State age.

STUDIO 139P, WASHINGTON SCHOOL OF ART
1115-15th Street, N. W. Washington, D. C.

LEARN WELDING

Both Electric Arc and Acetylene by practical Shop-Plan method in a few short weeks. No text-books. You learn by doing. Finest equipment. Low tuition. Pay-After-Graduation-Plan. Also, courses in Auto Mechanics, Collision Work, Metal Finishing, etc. Illustrated literature free. Write today.

MICHIGAN TRADE SCHOOL
3716 Woodward, Detroit, Mich. **Write for FREE FOLDER**

ENGINEERING

DEGREE IN TWO YEARS
TECHNICAL & APPLIED COURSES. Nonessentials omitted. TIME AND MONEY SAVED. Degree 2 yrs., diploma 1 yr. Electrical, Mechanical, Architectural, Structural, Civil, Aeronautical, including Air Conditioning, Refrigeration, Diesel. Intensive courses, 3 and 4 months in Electricity, Power Plant, Diesel, Refrigeration, Drafting. Extensive shop equipment. LOW TUITION. Part-time work for room and board. Thousands successful graduates in U.S. and foreign lands. Approved by industry, endorsed by educators, recommended by alumni. One and two-year courses open Sept. 18 to Oct. 18, short courses start specified dates, beginning Sept. 18, 41st Year. No home study courses. Catalog free.

FINLAY ENGINEERING COLLEGE
1003 Indiana Ave. Kansas City, Mo.

RADIO BOOKS 10c

Be a MONEY-MAKING RADIO EXPERT

I'll train you for a good job in Radio, Television, or a business of your own. My new, personalized sparetime home-study Course fits you quickly, easily. You get real Radio Equipment. I show you how to earn while you learn. Write for complete details in new catalog "HOW TO MAKE MONEY IN RADIO." **Sprayberry Academy** of Radio, 355-J University Place, N. W. Washington, D. C.

NEW WAY TO CHOOSE A CAREER

LET SCIENCE PICK A JOB FOR YOU!
TODAY, getting a job or choosing a career is no longer a hit-or-miss task. Science can now accurately determine for you, in advance just what type of work or profession you are best suited for. Send your name on a penny postcard for FREE booklet explaining this new proven way to greater success. Vocational Guidance Associates, Dept. 29, Tucson, Ariz.

MONEY for MEN ALL DATA FREE

THE PLASTEX Industry needs manufacturers on small scale and for big production of Lamp and Clock Stands, Art Goods and Novelties in Plastex and Marble imitation. Experience unnecessary. 1/2c material makes regular 10c store sellers. Rubber moulds furnished for speed production. Small investment brings big returns. "Goods BOUGHT and SOLD in large quantities." Ambitious men have chance for real prosperity. Our Free booklet will interest and benefit you. **PLASTEX INDUSTRIES, Dept. 2, 1085 Washington Ave., New York, N.Y.**



Become an Expert Accountant

The Profession that Pays

The demand for skilled accountants — men who really know their business — is unceasing. Big corporations are in constant need of expert counsel in Auditing, Cost Accounting, Business Law, Organization, Management, Finance. Men who prove their qualifications in this important branch of business are often promoted to responsible executive positions — given an opportunity to earn real salaries.

Send for This Book—It's Free

Are you ambitious to make a real success in business — to fit yourself for positions paying \$3,000, \$5,000, \$10,000 a year and even better? Then you will find LaSalle's 48-page book, "Accountancy, the Profession that Pays," of the greatest help and inspiration — and — LaSalle will send it to you FREE. For the sake of a brighter future, clip and mail the coupon NOW.

Find Yourself Through LaSalle! — — — —

LASALLE EXTENSION UNIVERSITY

A CORRESPONDENCE INSTITUTION
Dept. 983-HR Chicago

I should be glad to have details of your salary-increasing plan and a copy of "Ten Years Promotion in One," all without obligation.

- ☐ Higher Accountancy
- ☐ Business Management
- ☐ Modern Salesmanship
- ☐ Traffic Management
- ☐ Law—Degree of LL.B.
- ☐ Commercial Law
- ☐ Industrial Management
- ☐ Expert Bookkeeping
- ☐ Modern Business Correspondence
- ☐ Credit and Collection Correspondence
- ☐ Modern Foremanship
- ☐ C. P. A. Coaching
- ☐ Effective Speaking
- ☐ Stenotypy-Stenography



Name..... Age.....

Present Position.....

Address.....

New Catalog

—OF BARGAINS IN MILITARY, Outdoor and Sport Goods, Clothes, Shoes, Boots, Blankets, Tents, Firearms, Boy Scout Supplies, etc. Send 10c for copy to be redeemed on first order.

A AND N SUPPLY CO.
4784 Lester St.
RICHMOND, VIRGINIA



FOLLOW THIS MAN

Secret Service Operator No. 38 is on the job! Running down dangerous Counterfeit Gang. Tell-tale finger prints in murdered girl's room.

Free The Confidential Report Operator No. 38 made to his chief. Write for it.

Earn a Regular Monthly Salary
YOU can become a Finger Print Expert at home, in your spare time at small cost. Write for confidential full report and details. Literature will be sent only to persons stating their age.

INSTITUTE OF APPLIED SCIENCE
1920 Sunnyside Ave. Chicago, Ill.
Dept. 1366

Every handyman needs Smooth-On



SMOOTH-ON



You'll be surprised at the many ways in which Smooth-On No. 1 can save money in repairs around your home. Smooth-On is easy to apply, too, because it requires no heat or special tools, and the simple instructions are readily followed. The 40-page FREE Smooth-On Handbook is chock-full of time-saving and money-saving suggestions that will enable you to do perfect, lasting repair jobs that would otherwise require professional help.

Get Smooth-On No. 1 in 1 $\frac{3}{4}$ -oz., 7-oz., 1-lb. or 5-lb. can from your hardware store or, if necessary, from us. For your protection, insist on Smooth-On, used since 1895.

FREE

40-page Smooth-On Handbook, which every handy man should have to help keep mechanical equipment in perfect order in the home, and on the motor car and boat. Your copy sent free if you return the coupon.

What you can do with Smooth-On No. 1

Tighten Loose Parts
such as screws, bolts, nuts, locks, hinges, handles, casters, etc.

Seal Leaks
in pipes, boilers, heaters, tanks, radiators, etc.

Holds in metal, wood or masonry

SMOOTH-ON MFG. CO., Dept. 58,
574 Communipaw Ave.,
Jersey City, N. J.

Please send Smooth-On Repair Book.

Name.....

Address.....

9-40.....

**SMOOTH-ON
CEMENTS**



For the
**Motor Car and Boat,
Home, Factory and
Power Plant**

Do it with SMOOTH-ON



Only One Coat Required with Washable Paint

DIRT, grime, pencil marks, and even shoe-blackening and lipstick stains can be washed from walls finished with a single coat of a new paint that requires no primer, sealer, or undercoat even on porous brick or concrete walls. Said to make single-coat painting practicable, the finish can be sprayed on as well as brushed.



Installing a ball-bearing washer. At right, rubber cap with toothed edge for tight fit

Ball-Bearing Tap Washer

A NOVEL ball-bearing washer replacement for water faucets is said to eliminate wear and also prevent faucets from binding or sticking. The new type, pictured in the photographs above, utilizes a rubber-covered cap fitted with a toothed edge, and is installed in the same manner as conventional rubber washers.

Why Don't *You* Get Into Aviation with *these fellows?*

What is keeping you out of Aviation? These and hundreds more Aero ITI-trained men stepped directly into aircraft work upon graduation—and found Aviation the fascinating, opportunity-laden field they had looked forward to. Aero ITI training won them a sound start and a good job. It prepared them with the broad, thorough, intensely practical knowledge and abilities to advance along with Aviation's own swift and lasting development. Find out all about this proven Aero ITI way to an Aviation career. Send the coupon in **NOW**.

They Are Building Famous Training Planes



EXECUTIVE BOARD

JOHN K. NORTHPROP

President, Northrop Aircraft, Inc.

ROBERT E. GROSS

President, Lockheed Aircraft Corporation

C. A. VAN DUSEN

Vice-Pres., Consolidated Aircraft Corporation

AERO INDUSTRIES TECHNICAL INSTITUTE

5247 WEST SAN FERNANDO RD., LOS ANGELES, CALIF.

Five Courses in AIRCRAFT MECHANICS and AERONAUTICAL ENGINEERING... including U. S. Civil Aeronautics Authority Approved 12 Months Aircraft Mechanics Training

AERO INDUSTRIES TECHNICAL INSTITUTE, 5247 West San Fernando Road, Los Angeles, California

Please send information on Aero ITI training for Aviation careers. I am interested in the following branch of Aviation: ☐ Aircraft Mechanics; ☐ Aeronautical Engineering; ☐ Undecided. Years High School: ☐ 1, ☐ 2, ☐ 3, ☐ 4. Years College (Liberal Arts): ☐ 1, ☐ 2, ☐ 3, ☐ 4. Years Engineering College: ☐ 1, ☐ 2, ☐ 3, ☐ 4

Name _____ Age _____
Address _____
City _____
State _____ a-33-5

New York ^{Established 1902} Electrical School

Ask for free illustrated booklet

40 West 17th St., N. Y. C.

RADIO ENGINEERING

broadcasting, aviation and police radio, servicing, marine and Morse telegraphy taught thoroughly. 48 weeks' engineering course equivalent to three years' college radio work. School established 1874. All expenses low. Catalog free.

Dodge's Institute, Nye St., Valparaiso, Ind.

ARTISTS MAKE MONEY

Find out your ability. Send name, age, occupation and address for Free Vocational Art Test.

Federal Schools, Inc., 9140 Federal Schools Bldg., Minneapolis, Minn.

Free for Asthma

If you suffer with attacks of Asthma so terrible you choke and gasp for breath, if restful sleep is impossible because of the struggle to breathe, if you feel the disease is slowly wearing your life away, don't fail to send at once to the Frontier Asthma Co. for a **free trial** of a remarkable method. No matter where you live or whether you have any faith in any remedy under the Sun, send for this free trial. If you have suffered a lifetime and tried everything you could learn of without relief; even if you are utterly discouraged, do not abandon hope but send today for this free trial. It will cost you nothing. Address

Frontier Asthma Co.
462 Niagara St.,

293-F Frontier Bldg.
Buffalo, N. Y.



9000 NOVELTIES!

* 628 PAGES / NO OTHER CATALOG LIKE IT! * 5000 ILLUSTRATIONS

Nothing else quite like it. More interesting than a world's fair! Over 628 pages packed full of pictures, descriptions of odd items from all parts of the world—amusing, entertaining and useful articles some of which you've never known existed—hundreds not sold in stores—dozens of things you've wanted but never knew where to find. Amazing NEW catalog. Latest radio and hobby kits, newest styles of candid type cameras, fortune tellers, guns and rifles, sporting goods, books, seeds, etc., etc., in fact thousands of all the latest novelties, many unobtainable elsewhere.

Go thru your catalog when it arrives. Pick out a half dozen fun makers and put them to work at your party. "BINGO" shooters placed under telephones, plates, etc., explode violently but harmlessly. Auto Bombs, "Electric" Hand Shaker and Tickler, Trick Cards, etc., etc.

THIS GIVES SOME IDEA WHAT THE BOOK CONTAINS:

ELECTRIC EYE
MAGIC TRICKS
LIVE ANIMALS
ARCHERY SETS
MONEY SAVERS
TRANSMITTERS
FIELD GLASSES
CURIOUS SEEDS
INDOOR GAMES
SKELETON KEYS
MAKE UP GOODS
PRESS CARDS

RUBBER STAMPS
39c TYPEWRITER
JIG SAW PUZZLES
BANKS & VAULTS
SPORTING GOODS
NOVELTY CLOCKS
HUNTING KNIVES
SYMBOL JEWELRY
CIGARETTE CASES
GAMES OF CHANCE
FORTUNE TELLERS
ELECTRO-PLAYERS

FENCING SUPPLIES
INDIAN NOVELTIES
BOOKS FOR LOVERS
HULA HULA SHIRTS
OCCULT NOVELTIES
EXPLODING JOKERS
OVER 300 6c BOOKS
SWEATER EMBLEMS
FISHING SUPPLIES
RADIO & SUPPLIES
LIVE ART VILLAGES
PROJECTORS & FILM

RUSH 3c WITH THIS COUPON
Gigantic Catalog Of Unusual Novelties

Johnson Smith & Co.
Dept. 512, Detroit, Mich.

☐ Here's 3c. Rush Catalog

☐ DeLuxe Bound Cat. 15c

Name _____

Address _____

DE LUXE EDITION 15c
Beautiful cloth, permanent binding. De Luxe Edition for 15 cents.

Send 3c (15c for De Luxe cloth bound edition) for new catalog. Actually only 1-10th of cost! 628 page mammoth catalog—rotogravure section—8 color cover—9,000 amazing novelties—5,000 illustrations! Send 3c in any convenient form—unused U.S. stamps accepted.

JOHNSON SMITH & COMPANY, DEPT. 512, DETROIT, MICHIGAN

MAKE BIG MONEY

At Home! New Invention Electroplates by Brush

Plates
GOLD
SILVER
COPPER
TIN
CADMIUM
NICKEL

Easy as
painting

No Tanks, Liquids, Generators DOES SAME WORK AS BIG OUTFITS
Millions of old auto-parts, and all kinds of old, worn articles in homes, stores, offices, factories everywhere can now be electroplated with a permanent brand-new sparkling coat of metal—by electrolysis—with the stroke of a brush. Easy as painting—no dismantling—plates right on the spot. Any electric light socket or car battery. Weighs only a few pounds. Take it anywhere—ready for instant use.

Quick, Easy Way to Start Your Own Business

MAKE BIG PROFITS AT ONCE

Amazing low price and magic-like demonstration brings you thousands of orders for plating from garages, radio shops, bicycle shops, machine shops, home work shops, factories, offices, janitors, doctors, dentists, jewelers and farmers, homes, stores, etc.—with big profits for you! List of plating charges furnished; also reports of remarkable daily earnings.

2-MINUTE DEMONSTRATION WITH SAMPLE AMAZES EVERYBODY

Send today for FREE Sample and amazing profit details and bona fide reports of big steady earnings! Also, 3-way proven sure money-making plan. Get started at once on this permanent, profitable business. No competition. Simply mail name on penny post card—NOW! Be the exclusive Warner Nu-Way Electroplater in your community.

WARNER ELECTRIC COMPANY
Dept. 2-D, 360 N. Michigan Ave., Chicago, Ill.

**FREE
SAMPLE
PROVES
CLAIMS**

STUDY ENGINEERING AT HOME

Earn a Degree at Home

From A Chartered Institution of Higher Learning Employers Demand Degree Men For Key Positions

88 Degree Courses in Electrical, Civil, Mechanical, Drafting, Architectural, Automotive, Steam, Diesel, Aeronautical, Radio, Structural, Mining, Industrial, Highway, Petroleum, Marine, Refrigeration, Air Conditioning, Chemical Engineering, Arts, Sciences, Philosophy, Education, Public Health, Medical Jurisprudence, Psychology, Sociology, Physics, Chemistry, Geology, Pol. Science, Theology, Law, Agriculture, Business Training, Accounting, Statistics. Founded 1908. Chartered McKinley-Roosevelt Graduate College, 4750-B Sheridan Road, Chicago

LEARN COMMERCIAL

This is age of color and beauty—a golden era for illustrators and designers. Turn your drawing talent into money! Become a Professional Artist!

ART

Gain professional skill quickly in spare time at home. Send for free booklet and full details. Amateurs, here's your chance! Write:

SCHOOL OF APPLIED ART
Dept. 360, 10 E. Huron St., Chicago, Ill.

NEW PATENTED SHOES

PAY UP TO \$3.00 PROFIT! No experience needed. Be successful from the start taking orders for amazing new comfort invention in men's shoe styles. Nationwide SALES SENSATION! Demonstrator and everything needed for a mighty good cash income every day sent FREE. Get the largest and most complete sales outfit in the direct-selling shoe business ABSOLUTELY FREE from manufacturer established 37 years. Line includes 250 styles of dress, sport, work shoes. For men and women. Prices as low as \$1.98. WRITE TODAY!

MASON SHOE MANUFACTURING CO.
Dept. B-12 Chippewa Falls, Wis.



**FREE
SALES
OUTFIT**

Please mention POPULAR SCIENCE when writing to advertisers.



YOU'LL advance faster with an easy playing Conn. Choice of world's greatest artists. Many exclusive features yet they cost no more. Home trial. Easy payments. See your dealer or write for free book. Mention instrument.
C. G. CONN, Ltd. 932 Conn Bldg. ELKHART, IND.



CONN
BAND INSTRUMENTS

LEARN AVIATION

IN LOS ANGELES • Nation's Aviation Capital

Huge increase in Los Angeles aviation activity has assured splendid positions for graduates. Career training offered for airline piloting, engineering, mechanics, drafting, production mechanics and instruments. Train at one of America's most modern equipped and strategically located schools; fully approved by the government as a ground, flight and mechanics school. Write for free new 64 page catalog. State age.

CALIFORNIA FLYERS
SCHOOL OF AVIATION—Dept. PS-9
LOS ANGELES MUNICIPAL AIRPORT, INGLEWOOD, CALIF.

CARTOON YOUR WAY TO SUCCESS!



DON'T COPY—LEARN TO ORIGINATE!

RAYE BURNS will teach you HOW to CREATE ORIGINAL CARTOONS, at home, you may SELL! Cost is unusually low. Write for FREE sample lesson plates, drawing test, and addresses of successfully trained students. No obligation.
RAYE BURNS SCHOOL, Dept. S, Box 2194, CLEVELAND, OHIO

Promotion Begins at Home

Our graduates enjoy enviable positions as Engineers, Executives and experts in Architecture, Accountancy & C. P. A., Air Conditioning, Automotive, Commerce, Diesel, Electricity, Mfg., Merchandising, Salesmanship, Private Secretary, etc. Tell us what work you like—we'll send FREE Bulletin on home study. No obligation. Est. 1897.
American School, Dpt. P-646, Drexel at 58th, Chicago

TYPEWRITER Bargains

Send No Money—

Genuine Underwoods, Royals, etc., refinished \$100 office models greatly reduced to about 1/3 mfg's org'l price. 10 day trial—fully guaranteed—easy terms—10c a day. Free catalog. Limited supply.
231 W. Monroe St. International Typewriter Exch., Dept. 907, Chicago

BE A PASSENGER TRAFFIC INSPECTOR



Ambitious Men Succeed with our Training

You can qualify as Railway and Bus Traffic Inspector in a few months by our easy, home-study course, and on completion we'll place you at up to \$135 per month, plus expenses to start, or refund tuition. Pleasant, interesting work; travel if you like. Free Booklet describes our 21 yrs' service.

STANDARD BUSINESS TRAINING INSTITUTE, Div. 309 Buffalo, N. Y.

Get into the BAKING BUSINESS

Bakers make good money! Now 7th Industry in wages! Nearly depression-proof. New home study Baking Course qualifies you. Common school education sufficient. If you're ambitious, write for FREE BOOK, "Opportunities in Baking."
National Baking Institute, 3601 Michigan, Dept. 1366, Chicago



Earn Cash at Home!

We paid M. M. \$1174 for exceptional "cellar crop" SNOW-KING mushrooms! Big free picture book tells if your cellar, shed, barn suitable. We furnish materials, buy all crops thru our 25 branches. Established 1908. Write today.
United Co., 3848 Lincoln Ave., Dept. 341, Chicago.



SEND NO MONEY!—Save Money!



TRANSPARENT 60 Days' Trial! ROOFLESS PARTIAL
We make FALSE TEETH for you by MAIL from your own mouth-impression. Money-Back Guarantee of Satisfaction. Free impression material, directions, catalog.
U.S. Dental Co., Dept. 9-42 Chicago, Ill.

\$685 to \$35

Professional Model

Here's a Queer Way to Learn Music!

BE your own music teacher. Just a simple easy, home-study method. Takes only a few minutes—averages only a few cents—a day. Every step is clear as A-B-C. From the start you are learning real tunes by note. Learn to play "jazz" or classical selections—right at home in your spare time. All instruments.

FREE. Send for Free Booklet and Print and Picture Sample. These explain our wonderful home study method fully. Mention instrument preferred. Write today! Instruments supplied when needed, cash or credit.

U. S. School of Music
89 Brunswick Bldg., New York City



AVIATION APPRENTICES



AIRMINDED YOUNG MEN INTERESTED IN TRAINING FOR ENTERING THE WELL PAID FIELD OF AVIATION AS APPRENTICES—Write immediately, enclosing stamp.

MECHANIX UNIVERSAL AVIATION SERVICE CO.
Wayne County Airport Box 857 Dept. H Detroit, Michigan

AN AVIATION CAREER



OFFERS YOU GREAT FUTURE!

Demand for trained aircraftmen is increasing and already exceeds supply. Curtiss-Wright Tech. Aviation's foremost school, is located on Grand Central Air Terminal in heart of the aircraft industry and specializes in training MASTER MECHANICS and AERONAUTICAL ENGINEERS. (No flying involved.) Graduates are obtaining immediate employment. Write for details NOW. Dept. PS-9

Curtiss-Wright Technical Institute, Glendale (Los Angeles) California

Learn AUTO-DIESELS

Practical, tested training. Backed by 35 years experience. Course includes Auto Mechanics, Diesel Service and Operation, Diesel Power Generation, Machine Shop Practice, Auto Electrics, etc. Flexible plan to meet specific needs of those with or without jobs. Oldest, largest trade school in West qualifies you and helps you get a good pay job. Transportation allowed to L. A. Earn room and board while learning. Request Free Catalog.

NATIONAL SCHOOLS Dept. PSA-9
Los Angeles

Regain Perfect Speech, if you

STAMMER

Every stammerer should have the new 287 page book "Stammering, Its Cause and Correction". Sent free to stammerers. It describes the Bogue Unit Method for the scientific correction of stammering and stuttering. Method successfully used at Bogue Institute for 39 years—since 1901. Endorsed by physicians. Write for full information. No obligation.

Benjamin N. Bogue, Dept. 967 Circle Tower, Indianapolis, Indiana.

TOOL & DIE MAKING MACHINIST

Acety & Arc Welding, Body & Fender Repair, Practical Shop Training. Michigan's Oldest & Largest Trade School. Train until Satisfied.

WOLVERINE SCHOOL OF TRADES
1400 W. Fort St. Detroit, Mich. Dept. T-6



ONE YEAR GUARANTEE!

Sent ready to listen with instructions and tiny phone for use in homes, offices, hotels, in bed etc. **SIMPLE TO CONNECT—NO ELECTRICITY NEEDED!** SEND NO MONEY! Pay postman only \$2.99 plus Postage & charges on arrival or send \$2.99 (Check, M. O., Cash) and yours will be sent postpaid. A most unusual value. **ORDER NOW! FREE! PLUG IN "MAGICTENNA"** —ELIMINATES OUTSIDE WIRES!
MIDGET RADIO CO. Dept. PS-9 Kearney, Nebr.

COMING

FREE

50,000 BARGAINS

RESERVE YOUR COPY NOW!

LAFAYETTE'S GREATEST RADIO CATALOG

Never before a catalog like this. Tops every effort we've ever seen at catalog completeness, wide selection and value-giving. Here, literally, is everything in radio arranged for quick, easy reference. Take a tip—this book's a smash-hit—reserve your copy at once!

LOOK WHAT'S IN IT!

Radios—over sixty brilliant models—with every last-minute feature, beautiful new styling and power galore. Includes portables, table models, radio-phonographs, farm and auto receivers. Build-it-Yourself Radio Kits, complete nationally advertised parts, tubes, equipment and handy tools. Amateur radio and sound amplifying equipment—196 pages, and every page talks big value!

196 PAGES OF VALUES

SEE HOW MUCH YOU SAVE!

Prices in this catalog are all bed-rock low. You save on everything you buy. And deliveries to your door—no matter what the size of the order—is an added saving, in time as well as money. Here's a catalog you will certainly want.

HOW TO GET IT!

So great is the expected demand for this new, "last-word" edition of the greatest catalog in radio that we are asking you to reserve your copy in advance. All you need do is mail the coupon. A copy of Catalog No. 82 will be sent to you. Don't delay. Act now.

NEW YORK • CHICAGO • ATLANTA • BOSTON, MASS.
BRONX, N. Y. • JAMAICA, L. I. • NEWARK, N. J.

Lafayette Radio 20th Year of Radio Leadership

RUSH COUPON NOW

■ LAFAYETTE RADIO — DEPT. 9J
■ 901 W. JACKSON BLVD., CHICAGO, ILL.
■ or 100 SIXTH AVENUE, NEW YORK, N. Y.

I don't want to miss this great catalog. Please reserve my FREE copy.

NAME
ADDRESS
CITY STATE
PASTE COUPON ON PENNY POSTCARD

Please mention POPULAR SCIENCE when writing to advertisers.

BENNY GOODMAN ... "King of Swing" CHOOSES GRETSCH ... "King of Drums"

Big-time band leaders have to be right... they can't take a chance on instruments that may not deliver the goods! Therefore, when you buy a drum, make sure you get a GRETSCH, the same drum that BENNY GOODMAN and his ace-drummer NICK FATOOL feature in GOODMAN'S world-famed "No. 1" SWING BAND. And Benny selected not only one GRETSCH OUTFIT, but TWO—a GRETSCH-GLADSTONE for full band use... a GRETSCH-BROADCASTER for the famous GOODMAN SEX-TETTE. GRETSCH, oldest drum makers in America, makes a drum for every purpose and every purse—\$5 to \$500.



NICK FATOOL
Goodman's
Star Drummer

**EASY
TO
PLAY
★
EASY
TO
PAY**

Send penny postcard for literature and FREE photograph of your favorite drummer; also full information about EASY-PAYMENT PLAN and FREE trial. Give street number; address Dept. PS 91.

The FRED. GRETSCH MFG. CO.
Musical Instrument Makers Since 1883
60 BROADWAY, BROOKLYN, N. Y.

GRETSCH also offers SUPER VALUES in Guitars, Saxophones, Trumpets, Trombones, Accordions.
Send for FREE catalogue. Mention instrument.

HEMPHILL DIESEL SCHOOLS

All communications concerning enrollment in any of the Hemphill Diesel Courses should be sent to one of the following addresses:

NEW YORK . . . 31-32 Queens Blvd., L. I. C.
CHICAGO . . . 2006 Larrabee Street
MEMPHIS . . . 431 Monroe Avenue
LOS ANGELES . . . 2012 San Fernando Road
VANCOUVER, B. C. . . . 1365 Granville St.

HEMPHILL DIESEL SCHOOLS (use nearest address)

★ Please send data on your Diesel courses, also free copy of illustrated booklet "March of Diesel."

Name _____ Age _____

Street _____

City _____ State _____ m-49-s

Also Diesel course in Spanish for Latin American students. Write for information and terms.

**Learn
PHOTOGRAPHY
at Home**

Splendid opportunities. Prepare in spare time. Easy plan. No previous experience needed, common school education sufficient. Send for free booklet "Opportunities in Photography", particulars and requirements.

American School of Photography
3601 Michigan Ave., Dept. 1366, Chicago, Ill.

LEARN *Marine* NAVIGATION

Entire subject in ONE volume

Whether you are interested in Marine Navigation for pleasure or as a career here is the book you need! New, complete, up-to-date manual by the outstanding authority, Lieut. Commander P. V. H. Weems, U.S. Navy Retired. Covers Dead Reckoning, Piloting, Radio and Celestial Navigation, Meteorology, etc. High education not required. 450 pages, handsomely bound; hundreds of pictures, charts, diagrams. SEND NO MONEY—Read it 10 days FREE. Then return it or send \$2.00 and \$2.00 a month until \$6.00 total price is paid. The only work of its kind. Send today.

D. VAN NOSTRAND CO.
Dept. B, 250 Fourth Ave., New York

WOODWORKER'S Turning & Joining MANUAL



This new manual is written especially for the man who likes to make things in his own home with power tools. Tells what power machinery you will need to

turn out beautifully finished furniture. How to use the cross cut saw, rip saw, miter saw, jointer, and band saw. How to bore and mortise by machinery.

Scraping method of wood turning fully explained—how to turn a plain cylinder, smooth cylinder, how to use a skew chisel to square ends, how to make shoulder cuts, taper cuts, convex and concave cuts. How to make a tilt-top table, occasional table, reeding and fluting, faceplate and chuck turning, turning rings, veneering. How to make the surface perfect, how to apply stain, wood fillers, finishes—wax, oil, shellac, varnish, lacquer.

Also, how to equip your home workshop, what hand tools you will need in addition to power machinery. All about wood joints.

Complete working diagrams with step-by-step instructions for intricate designs in cabinet making, 236 illustrations, 192 pages, full cloth bound, only \$1.00 C.O.D. Send order WITH NO MONEY for WOODWORKER'S TURNING AND JOINING MANUAL. Pay postman \$1.00 plus few cents postage when book arrives.

POPULAR SCIENCE—Dept. 90

353 Fourth Ave.

New York, N. Y.



Wonders Through The MICROSCOPE

A new book which tells you all about MICROSCOPY. Turn an inexpensive microscope on hundreds of specimens within a stone's throw of your front door and you step off into a new world of wonders. Complete manual for amateurs. How to use equipment, secure and preserve specimens, take photomicrographs, etc. Numerous illustrations. Full cloth bound \$1.00.

POPULAR SCIENCE MONTHLY, Dept. 90

353 Fourth Ave.

New York, N. Y.



The HOME CHEMIST

A new book which shows how to set up and operate an inexpensive home laboratory with odds and ends of material available in every home. Many thrilling, practical, useful experiments and tests, entertaining, instructive, valuable, pointing the way to research and new discoveries. Many diagrams and illustrations. Full cloth bound \$1.00.

POPULAR SCIENCE MONTHLY, Dept. 90

353 Fourth Ave.

New York, N. Y.

LET ME PROVE I CAN MAKE YOU A NEW MAN

I changed myself from a 97-lb. weakling to winner of title, "World's Most Perfectly Developed Man." Let me prove that my secret of Dynamic Tension can give you powerful muscles, smashing strength, a handsome build? All I ask is a 7 DAY TRIAL. Write for my 48-page FREE BOOK. CHARLES ATLAS, Dept. 19, 115 East 23rd Street, New York City.

SEND
FOR MY
FREE BOOK



LEARN AVIATION . . . At Lewis

All branches taught quickly, soundly, at Lewis School of Aeronautics. Become master airplane mechanic, or pilot, in 12 months. OR, take full 4-year aeronautical course. School accredited, certified by Civil Aeronautics Authority. Famed flyer instructors. Mile-wide airport. Low tuition. WRITE FOR FREE CATALOG.

LEWIS SCHOOL OF AERONAUTICS
Dept. P, Lockport, Illinois

MECHANICS **FREE SAMPLE** PISTON RINGS!

SENSATIONAL NEW KIND OF Spectacular new replacement piston ring invention—Look! Unbreakable! No breaking in! No expanders needed! Guaranteed 100,000 miles! No rebor-ing, honing or grinding. Amazing self-locking design gives top compression, lowest oil consumption. And you buy at FACTORY DISCOUNTS—make money on every ring job. Seeing is believing. Send your name for Absolutely Free Sample, postage prepaid. Penny postcard will do. Address TRIPLE-X ENG. CO., Dept. 139, 3801 S. Racine Ave., Chicago, Ill.



4000 BARGAINS

You will find illustrated, many handy articles for the small work-shop and home, also office specialties, carded goods, food products, etc., at wholesale prices, for agents, dealers, salesmen. All sold under a money back guarantee.

260 Page Wholesale Book.

Cost about 25c. yours for 10c to cover cost of mailing, packing, etc. You get your dime back with first order. Hurry your request for the catalog—today. Spors Co., 7-40 Frank, Le Center, Minn.

BRUSH PLATING OUTFITS

for autoparts, reflectors, faucets, bicycles.
No tanks necessary. Free particulars.

GUNMETAL CO., AVE. F, DECATUR, ILLINOIS

IT'S EASY TO MAKE BIG SPARE TIME MONEY

Send for our free plan on how to make \$5.00 to \$15.00 a week in your spare time by taking orders for POPULAR SCIENCE MONTHLY from your friends. No selling required. Turn extra hours into extra dollars.

POPULAR SCIENCE MONTHLY

353 Fourth Ave. Dept. 90 New York, N. Y.

AIRCRAFT WELDING ENGINEERING

Industry Offers Outstanding Opportunities to properly trained Commercial Welding Engineers (1 year), Welding Technicians (5 months), Aircraft Welders and Arc Welding Operators (3 months). Learn By Doing. Earn Part Expenses—Write for free 64-page illustrated Book—"Dawn Of A Giant Industry." Mention course desired.

MILWAUKEE SCHOOL OF ENGINEERING
PS-940—N. BROADWAY & E. STATE, MILWAUKEE, WIS.

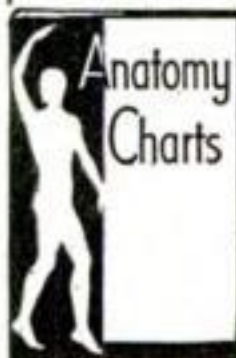


Learn this Profitable Profession



in 90 Days at Home

Hundreds of men and women of all ages 18-50 make \$10.00 to \$20.00 in a single day giving scientific Swedish Massage and Hydro-Therapy treatments. There is a big demand from Hospitals, Sanitariums, Clubs, Doctors and private patients as well as opportunities for establishing your own office. Learn this interesting money-making profession in your own home by mail, through our home study course. Same instructors as in our NATIONALLY KNOWN resident school. A diploma is awarded upon completion of the course. Course can be completed in 3 to 4 months. High School training is not necessary. Many earn big money while learning.



Anatomy Charts & Booklet FREE

Enroll now and we will include uniform coat, medical dictionary, patented reducing roller and Hydro-Therapy supplies without extra cost. The reducing course alone may be worth many times the modest tuition fee.

Send coupon now for Anatomy Charts and booklet containing photographs and letters from successful graduates. These will all be sent postpaid—FREE.

THE College of Swedish Massage (Successor to National College of Massage)
Dept. 670, 30 E. Adams St., Chicago.

You may send me FREE and postpaid, Anatomy Charts, booklet containing photographs and letters from graduates, and complete details of your offer.

Name

Address

City State



WANT A
GOVERNMENT
JOB?



START \$1260 to \$2100 YEAR

Many appointments
each year.

Franklin Institute
Dept. G245
Rochester, N. Y.

Men—Women

32 Page Civil Service Book—FREE

Gentlemen: Rush to me, FREE of charge, list of U. S. Government big pay dependable jobs. Send FREE 32-page book describing salaries, vacations, hours, work, etc. Tell me how to qualify for one of these jobs.

Mail Coupon
Today—
SURE

Name

Address

For More Pay Train To Enter DRAFTING INDUSTRIAL DESIGN

Get into a Better Pay field with a big future by learning DRAFTING and DESIGNING quickly from an Engineer and Industrial Designer. Private, individual training at your home. Drawing tools and table furnished without extra cost. Learn to draw and design new products, or to improve, re-style, streamline and modernize old products for more "eye appeal" and selling power.

Drafting is a very big field, but drafting with industrial designing is twice as big. Factories must continuously bring out new models, new products, and improved designs. You can learn both subjects right in your own home, in your spare time. You can be trained for better pay as I have trained many hundred successful students. I'll train you thoroughly by applied instruction on actual work until you are holding a good paying position. Write for complete details on "Drafting and Industrial Designing."

ENGINEER DOBE

LIBERTYVILLE, ILLINOIS

Dept. 3396

Want a Career in Photography?

Ever consider photography as a money-making career? Fascinating field. Splendid opportunities. Practical, thorough, individual training under expert personal guidance. Commercial, News, Portrait, Advertising, Motion Picture, and Color Photography. Learn for pleasure or career. Personal Attendance and Home Study courses. Booklet FREE!

NEW YORK INSTITUTE OF PHOTOGRAPHY
10 West 33rd Street (Dept. 5) New York City

Big Money for Workers In Home or Shop



MONEY-MAKING PROJECTS. Color-glazed concrete lawn, cemetery pottery made without molds or cores. New, Patented method. Use only sand, cement, cheap materials. Tiles, walls, gravestones. Statuary, giftware. Basement waterproofing. Booklet, details 3c stamp.

NATIONAL POTTERIES COMPANY

Dept. 7, 13 W. 26th St. Minneapolis, Minn.

NOW ONLY

\$4.95

REAL ENGINE VALUE



Over 7,000 GHQ Gas Engine Kits were sold at \$8.50. Over 15,000 sold last year. Now is your chance to buy the *New Improved* kit for \$4.95. Absolutely complete with coil, plug, etc. 1 1/2 H.P. All parts guaranteed. Only a screwdriver needed. For boats, planes, etc. Send only \$1. Shipped Exp. Coll. C. O. D. same day. Send for FREE literature or 6c for Jumbo hobby catalog.

FACTORY ASSEMBLED—READY TO RUN \$6.95

GHQ MOTORS, 40S East 21 St., New York, N.Y.

MYSTERIOUS DEVICE WELDS BRAZES ANYONE CAN OPERATE AND SOLDERS



Now, an electric welding, brazing and soldering Torch, complete with power unit, goggles and supplies. **Works INSTANTLY off any light socket.** Does a thousand and one repair jobs at amazingly LOW COST on aluminum, iron, steel and other metals. **Indispensable** for Auto, Body and Fender Repairs, and home repairs—shop, factory, farm, engineer, janitor, sheet metal, radio and bicycle repairs. Anyone can handle without previous experience with our simple instructions. **10-DAY HOME TRIAL** Write at once for Special Introductory Low Price Offer. Try 3 in 1 Electric Torch for 10 days at our risk, or get one free by helping to introduce it. **ELECTRO-TORCH CO., 2613-LH, Michigan Ave., Chicago**

Please mention POPULAR SCIENCE when writing to advertisers.

READY New 1000 SHOT **\$2.95** Only DUTY ADDED IN CANADA

RED RYDER 16 INCH LEATHER SADDLE THONG
Cowboy CARBINE

Featuring: Golden Bands! Western Carbine Ring! Red Ryder BRAND on stock! Lightning-Loader Device! \$2.95 at Dealers. If he hasn't it, send us \$2.95... we'll mail yours postpaid! Write for FREE Daisy Air Rifle Catalog!

DAISY MANUFACTURING COMPANY 559 Union St., Plymouth, Michigan, USA.



MONEY IN RABBITS-CAVIES

WE BUY and put you in touch with other markets. Catalog and copy of magazine 10c. Or send 25c for Book Catalog and Price List and Year's Subscription to the AMERICAN SMALL STOCK FARMER. **OUTDOOR ENTERPRISE CO., BOX 922 NEW CITY, N. Y.**



SAVE on TENNIS BADMINTON STRINGS SAVE on our NEW LOW PRICES

Earn money—save money re-stringing rackets! Buy Gut tennis strings direct from factory. Silk strings; Re-stringer's vices, equipment, instructions. Catalog FREE. **H. E. WILLS CO., 1047 W. 47th St., Dept. PS-90, Chicago**

FREE!

SOUND SYSTEMS CATALOG

Just write Dept. PS-35

Chicago, Illinois

MONTGOMERY WARD



Begin today. Write for our New Free Book, "How to Become a Good Penman." It contains specimens and tells how others learned to write in spare time. Enclose 10c for a Professional Pen Point and your name beautifully written. Write today. **THE TAMBLYN SCHOOL OF PENMANSHIP 439 Ridge Building, Kansas City, Mo.**

FORGE AHEAD

with the Thinking Alphabet. New "exactly how" short cut to self advancement through self-discovery, originality, personality and mind training. Free booklet. **Self Advancement Inst., 99A Fern St., Philadelphia**



MECHANICAL DENTISTRY

Short course—personal, individual, instruction—best technical teachers. Profession offers unlimited opportunity—not affected by Machine Age. Most modern and complete methods embracing every branch from plate to porcelain work. Qualifies you to work for dentists or own business. Day or night school. No books—no classes. Catalog upon request.

OR STUDY AT HOME. Write for information on our Home Study Course. **MCCARRIE SCHOOL OF MECHANICAL DENTISTRY 207 N. Broad St. Dept. 678 Philadelphia, Pa.**

DO YOU OWN A RAILROAD?

Here at last is a new and complete handbook for the Model Railway enthusiast. Shows you how to save real money building and laying your own track, making an automatic signal system, constructing bridges, culverts, tunnels, stations, semaphores, water tanks, coal-ing trestles, roundhouses, turntables, crossing gates, switches, etc. The detailed instructions and diagrams in this great book make it easy.

EVERY MODEL RAILWAY ENTHUSIAST NEEDS THIS NEW BOOK

Tells you how to utilize every bit of available space in laying out your system. How to turn out smoke stacks, fire boxes, boilers, and wheels, in your own shop. Complete, easy-to-follow instructions for building a box car, gondola, refrigerator, tank, hopper, caboose, day coach, pullman, baggage, and observation car. Complete plans, specification, instructions, and scale blueprint for building the popular Atlantic type locomotive.

Send only \$2.00 for your copy of Model Railways or we will ship C. O. D. plus a few cents postage. Satisfaction guaranteed or money back. Address

Popular Science Monthly, Dept. 90 353 Fourth Ave. New York, N. Y.

POPULAR SCIENCE

Classified

OPPORTUNITIES

**MONEY-MAKING,
MONEY-SAVING**



Classified Ads only 35c per word per insertion, payable in advance. Minimum ad 10 words. To be included in November issue copy should be in our office by August 24. November issue on sale October 1
POPULAR SCIENCE MONTHLY—351 FOURTH AVE.—NEW YORK CITY

ADVERTISING

MAIL-ORDER or agent ad reaching 1,000,000 families throughout United States \$14.00 inch. Newspaper, magazine, mailing-list, ratebook, free. Chicago Advertising Agency, 20-SP West Jackson, Chicago.

LEARN Advertising at home. Easy practical plan. No text books. Common school education sufficient. Interesting booklet and requirements free. Page-Davis School of Advertising, 3601 Michigan Avenue, Dept. 1742, Chicago.

ADVERTISE: newspapers, magazines, periodicals, lists free. Fidelity Advertisers, 3838-K Washington, Chicago.

FIVE column-inches display advertising in 25 newspapers for \$15. or trade. Footprints, Fountain Green, Ill.

ADVERTISE: 24 words, 149 newspapers \$6.50. Lists free. Advertising Bureau, 4515-P Cottage Grove, Chicago.

AGENTS WANTED

SENSATIONAL quick - cash opportunity. My route building plan gives you chance for good steady income. Real future. Handle regular route local stores. Collect, deliver orders for famous 5c—10c counter display goods. Nationally advertised in 120 magazines and radio. Show merchants proven plan for beating competition and increasing sales, profits. Experience unnecessary. Use home as headquarters. Chance to operate Silver Fleet Service Truck. Facts free. World's Products Co., Dept. 83-C, Spencer, Ind.

CALL on friends with sensational lowest-priced Personal Christmas Cards and stationery. Names imprinted. Also big-value 21 card \$1.00 assortment. Profit, 50c. Experience unnecessary. Samples Free. Wallace Brown, 225 Fifth Ave., Dept. R-35, New York.

SELL Christmas Card sensation! New "Beauty Queen" 21-card assortment leads in value, appeal. Sells \$1—you make 50c. Ten other assortments. Personal Christmas Cards with name 50 for \$1. up. Samples on approval. Chilton Greetings, 147 Essex, Dept. X-41, Boston, Mass.

CHRISTMAS Card Bargains. Sell 50 personal Christmas cards for \$1. All beautiful folders with customer's name inscribed. Liberal profit. Free samples. Also marvelous value \$1.00 Box assortments. General Card, 400 S. Peoria St., Dept. P-73, Chicago.

CHRISTMAS Card Money-Makers! Sensational \$1 assortment 21 Christmas cards starts you making money now—50c profit. Other fast-selling assortments. Personal Christmas Cards, 50 for \$1. 50c sample on approval. Schwer, Dept. V-5, Westfield, Mass.

WRITE for Free samples amazing stain-proof tablecloths. Clean with damp cloth. Require no ironing. Beautiful patterns. Look like linen—cost much less. Commissions big. Also complete line of dresses. Melville Company, Dept. 1665, Cincinnati, Ohio.

SELL new idea Christmas Cards—21 for \$1. Can be "Personalized" to relatives with Free metallic Gold Seals. Make 100% profit. Name-imprinted Christmas Cards, 50 for \$1. Samples on approval. Friendship, 858 Adams, Elmira, New York.

READ CAREFULLY

These Classified Advertisements, under more than 110 classifications, contain a gold-mine of interesting, useful information. Among them you'll find many money-saving and money-making opportunities; new products and services. Make it a habit to read this section every month. It pays.

MAKE Money! Fast selling Personal Christmas Cards with name 50 for \$1. up. 100 designs. Also 21-card "Feature" box assortment \$1. You make 50c. Samples on approval. Janes Art Studios, 460 Anson Place, Rochester, New York.

YOUR ad in this Classification will reach productive sales-getters for your products or services. Rates on request. Popular Science Classified, 353 Fourth Ave., N.Y.C.

SELL 50 Christmas cards with name for \$1.00! Four complete, sensational lines! 35 sparkling designs! Amazing values! Box assortments too. Big profits. Experience unnecessary. Samples Free. Noel Studios, 9 East 26th, Dept. C-26, New York City.

BIG Profits selling famous Waltham Christmas Cards. 21-card \$1 assortment pays you 50c. Christmas Cards with name, 50 for \$1. Complete line. Samples on approval. Waltham Art Publishers, 160 N. Washington, Dept. 334, Boston, Mass.

SELL season's Christmas Card hit! America's finest 21-card assortment, \$1. Your profit 100%. Big selection assortments. Personal Christmas Cards low as 50 for \$1. Free samples. Wetmore & Sugden, 749 Monroe, Dept. 115, Rochester, New York.

ONLY two sales per day makes over \$1200.00 monthly profits. Auto tools. Every mechanic a prospect. 95% virgin. \$50.00 sales makes \$36.00 profits. New. Proven. Protected territory to producers. Year around demand. Mesco, Beaver City, Nebr.

COIN Checks: Slugs, razor blades, trick playing cards, etc. Rush 10c for sample layout. Low wholesale prices to agents. De Vere Novelty Co., Dept. 37, Dayton, Ohio.

WILL you give us 5% first \$600 you make? Afternoons free! Work home! \$1,000 month reported (exceptional—fulltime). Expect surprise! National-3, BX1240, San Bernardino, Calif.

BIG money taking orders; shirts, ties, hosiery, underwear, pants, jackets, raincoats, uniforms, etc. Sales equipment Free. Experience unnecessary. Nimrod, 4922-AV Lincoln, Chicago.

NEW! Sensational! Push-Button controlled gas tank lock. Electric—Operates from dash. Sold on new Graham Car. Distributors, dealers, here is greatest money-maker out. Write Today. Snap-Up, Ashland, Ky.

BUSINESS proposition resilvering mirrors, reflectors, making chipped glass nameplates, signs. Write Sprinkle, Plater, 910, Marion, Ind.

SELL bankrupt clothing bargains from home, store, auto. Shoes 15c—Men's suits, overcoats, 75c—dresses 10c. Experience unnecessary. Free wholesale Catalog. Superior Jobbing, 1250-DA Jefferson, Chicago.

IF you are ambitious you can make good money with a Rawleigh Route. We help you get started. No experience needed to start. Steady work for right man. Write Rawleigh's, Box I-2-PSC, Freeport, Ill.

WE Pay You \$5 for selling ten \$1 boxes. 50 distinctive assorted name imprinted Christmas cards. Sell \$1. You make 50c. Free samples. Cheerful Card Co., 57 White Plains, N. Y.

AT home, your own manufacturing business, making popular \$1.00 novelties. Cost you 3c to 15c. Everything supplied. Write So-Lo Works, Dept. L-824, Cincinnati, Ohio.

BIG money applying initials on automobiles. Easiest thing today. Free samples. Also, sideline salesmen for short order Decalcomania name plates. "Ralco," 1305 Washington, Boston, Mass.

AGENTS: Opportunity make money; book containing 127 successful business plans; home-office; send for free introductory booklet, Elite Co., 214-A Grand St., New York.

GOOD Paying business silvering mirrors, plating autoparts, reflectors, bicycles, bathroom fixtures by late method. Free particulars and proofs. Gunmetal Co., Ave. G, Decatur, Ill.

CHRISTMAS Cards. Finest line. Best commissions. 400 Christmas books—Bibles. Shipped on credit. Write to Mead Publishing Co., Dept. 20, Middletown, N. Y.

AMAZING new zipper clothesline. Zip garments on or off. Instant demonstration, sure sale every home. Dunn Mfg., Hempstead, N. Y.

FREE water and our concentrates make 68 products. We supply labels, bottles. Enormous profits. Qualco, F-20030 Russell, Detroit.

WINDOW sign letters. Penny each. Large sizes. New styles. Absolutely beautiful. Free samples. Atlas, 7941-R Halsted, Chicago.

FREE sample—amazing cleaner; sells homes, taverns, everywhere. Big profit—fast repeater. Besco, 5009-X, Irving Park, Chicago.

MEXICAN Curios sell on sight. Large profits. Free particulars. Samples 10c stamps. Marquez-IW, Apartado 1176, Mexico City.

AGENTS—300% Profit selling Gold Leaf letters; stores and offices. Free samples. Metallic Letter Co., 437 North Clark, Chicago.

LOWER prices: Extracts, toiletries, polishes, concentrates. LaPura, 711½ Summit, Toledo, Ohio.

CHRISTMAS Cards—Absolutely Finest Assortment. Big profits. Write for samples. Robinson Cards, Dept. 613, Clinton, Mass.

CHRISTMAS Cards. Sell 50 assorted folders, name imprinted \$1.00—Cost you 50c. Samples free. Dunbar, New Brunswick, N.J.

MILLIONS sold. Sample 15c. Joseph Curin, 1807 Carpenter St., Chicago.

ANTIQUES, RELICS INDIAN GOODS

30 GENUINE Indian arrowheads, \$1.00. Catalog. George Holder, Glenwood, Ark.

INDIAN relics. Confederate bills, coins, gems, crystals, minerals, curios; catalog 52 illustrations 5c. 100 ancient arrowheads \$3.00. Tomahawk head 50c. H. Daniel, Hot Springs, Ark.

SWORDS. Rapier, Daggers, Pistols. Catalog 10c. Robert Abels, 860½ Lexington Avenue, New York.

AUTHORS' SERVICE

STORIES, novels revised and typewritten for marketing. Welton Tinney, Winnsboro, Texas.

PUBLISHERS need manuscripts. Information Free. Besner-P.S., 30 Church, New York.

AUTOMOBILES

SUPERCHARGERS \$3.00. Guaranteed mileage increase 20%; power 10%. University of Detroit test. Any car; give make, year. Wrench installs 15 minutes. John Hanley, Manufacturer, 5719 Loraine, Detroit, Mich.

PROFESSIONAL Midget racers, two-passenger roadsters, midget motorcycles, motor-scooters. Guaranteed motors, wheels, parts, plans. Handbook catalog—90 illustrations—20c. Midwest, Box 1959-BC, Chicago.

MIDGET and Motorscooter plans, parts, building kits. Circulars Free. Catalog, 10c. Latest list 100 used motors, midgets, parts, 20c. Shipps Midgets, Box 543-K, Zanesville, Ohio.

AUTO SUPPLIES & EQUIPMENT

CONVERT your car to burn Diesel oil. Save up to 70% fuel costs. Cheap installation. Wonderful performance. Proven factory method. Different and better. Costs nothing to investigate. Write for free circular No. 3. Harrington Company, 201-204 Manchester Bldg., Portland, Oregon.

BUY Tires direct and save! Goodyear, Goodrich, other brands factory retread tires special \$2.95; all passenger sizes; warranted 12 months service; \$1.00 deposit with each tire, balance C.O.D. 5% allowed for cash in full with order. American Tire Co., 1454 E. 17 St., Cleveland, Ohio.

FUEL oil conversions—For automotive, marine engines. Write for free literature. Houston & Logan, 2112 Addison, Berkeley, California.

BARGAINS—Welders, compressors, battery chargers, car washers. Liberal trial terms. Write Hobart Equipment, Box P-9403, Troy, Ohio.

OIL reclaimed Free. Guaranteed plans \$1.00. Literature. Wayne Engineering Co., Greenville, Ohio.

AVIATION

GET into Aviation! Train now at this Lincoln Aeronautical Institute for responsible position as Aeronautical engineer, air transport pilot, aviation mechanic or aircraft sheet metal craftsman. Good jobs open! Big money paid! We assist graduates in locating positions. Part time employment for board and room while in training. Write today for information. Lincoln Aeronautical Institute, (Inc.), Lincoln Airplane & Flying School Division, 2104 Aircraft Bldg., Lincoln, Nebr.

AVIATION workers are in demand. Prepare yourself by learning Blueprint Reading. Send 3c postage for descriptive booklet. Baltimore School of Aviation, Box 32, Hamilton Station, Baltimore, Md.

AIRLINER propellers, all types. Aircraft supplies. Ford A conversion diagrams with instructions, 25c. Standard Aircraft, Ft. Worth, Texas.

PROPELLERS—All types. World's largest propeller catalog 10c. Banks Propellers, Love Field, Dallas, Texas.

AVIATION Apprentices: Air-minded Young Men interested in training for entering Aviation as Apprentices see ad on page 29.

LEARN to fly free. Folder, dime. Ohmeyer, Box 391B, Hempstead, N. Y.

BATTERIES, GENERATORS, ETC.

EDISON storage batteries for lighting and power. Non-acid. Odorless. Fifteen year life. Five year unconditional guarantees. Reasonably priced. Tremendous savings in battery and light plant combinations. Free illustrated literature. See-Jay Co., 87 Sterling Ave., Yonkers, N. Y.

AC Electricity with Katolight plants & generators \$44.50 upwards. Katolight Corp., Mankato, Minn.

EDISON lifetime storage batteries for light and power. Eliminate acid battery diseases. Long guarantee. All kinds rebuilt generating plants, motors, and miscellaneous articles at bargain prices. Free interesting literature. W. Hawley Smith Company, Croton Falls, N. Y.

BLUEPRINTS & PLANS

628 PAGE Catalog. 9000 Novelties, puzzles, tricks, hobbies, guns, novelty jewelry, radios, cameras, etc. 3c. Johnson Smith, Dept. 511-X, Detroit.

BOATS, OUTBOARD MOTORS, ETC.

FULL size, cut-to-shape Boat patterns, blueprints and specifications. Big selection. Bargains. Send 10c (coin) for illustrated catalog. Book, "How to Build Boats", \$1.00 postpaid. Cleveland Boat Blueprint Co., Station A-77, Cleveland, Ohio.

MARINE Power. Easily convert any Ford motor (domestic and foreign) with Osco Parts and Kits. Complete Catalogue 25c (coin). Osmithson, 3648-P Lawrence St., Philadelphia, Pa.

SPEEDOMETERS for Outboard boats. Two models—O-35 MPH, 10-55 MPH. \$6.95 each. Write for folder. Aqua Meter Co., 60 Glenwood Rd., Upper Montclair, N. J.

OUTBOARD Motors. Used and Rebuilt. Save money. Used parts. Bargain list free. Crandall-Hicks, 955 Commonwealth, Boston, Mass.

MARINE Conversion Parts for all auto engines. Buy here and save. Conversion Parts Co., 277 Adams St., Boston, Mass.

KAYAKS. Outboards. Rowboats. Weldwood ready-cut kits. Catalog. Cre-Craft Boats, Dept. I, Millburn, New Jersey.

EASY built Kayaks—Inboards—Outboards—Rowboats. Complete kits. Catalog 10c. Kayak Boat, 154-A East 129th, New York.

BODY-BUILDING COURSES

EXERCISE equipment, courses. Special offers! Free booklet. Good Barbell Co., Dept. 6, Reading, Pa.

BOOKS, PERIODICALS

CELLOPHANE book page protector with colored thumb-caps for visibility. Eliminates undue wear and soiling by protecting pages from reader's hands. Elias E. Lemire, 402 Ave. F., Cloquet, Minn.

EXCELLENT Sparetime profits taking subscriptions—2500 magazines. Agents confidential catalogue, complete starting supplies Free! Dept. 43, Pines, 583 Monroe, Brooklyn, N. Y.

SNAPPY books, pictures, novelties, etc. Where to get. We tell you. List only 25c. Esse, 5000-A Cordelia Ave., Baltimore, Md.

BUILD IT YOURSELF

BUILD your own machine tools. Castings and Blue Prints at nominal cost. Send 10c for 2 color 28 page catalog. 34 prints covering 12 metal-working projects, \$1.50. 23 prints covering 6 wood-working projects, \$1.00. Lewis Machine Tool Co., Dept. S-9C, 2051 Santa Fe Ave., Los Angeles.

BUILD power Scooters, midget cars. We supply tires, wheels, motors. Lowest prices. Send 10c for plans, etc. Bild-Ur-Own Devices, Dept. 9-B, 536 North Parkside, Chicago.

MOTORSCOOTERS, Midget cars! Easily built. Complete plans and literature on wheels, tires, motors, transmissions, clutches, etc., 10c. Honsaker, Masontown, Pa.

A-C Welder for \$10 without winding. Several plans \$1.00. Information dime. Hi-Point Electric Products, Dept. S., Bellefontaine, Ohio.

100 MILES PER HOUR—Fords, Chevrolets, Plymouths. Plans \$1.00. Emblem Co., 200 LeCompte Pl., San Antonio, Tex.

SEAWORTHY 12' rowboat, construction plans, 25c. Dillabaugh, Box 1855, Portland, Oregon.

BUSINESS OPPORTUNITIES

PLASTEX Industries offer industrious men an opportunity to start a business of their own, manufacturing art goods, novelties and utility products in Plastex and marble imitation. ½c material makes regular 10c store seller. Rubber molds furnished for speed production. Small investment brings big returns. War starting to cause big shortage of these goods. Ambitious men have chance for real prosperity. Plastex Industries, Dept. S., 1085 Washington Ave., New York, N. Y.

ANNOUNCING new home study course in commercial baking. Good field for ambitious men. Nearly depression proof business. Common school education sufficient. Send for free booklet "Opportunities in the Baking Industry" and requirements. National Baking Institute, 3601 Michigan Ave., Dept. 1745, Chicago.

START home business making statuary: plaques; art goods; novelties; souvenirs; concrete pottery; garden furniture; artificial marble flooring; liquid marble. Make your own flexible molds. Amazing profits. Valuable folder free. Creative Publishers, P.S.9, Glencoe, Ill.

MAIL Order business course shows you how to make money, spare or fulltime. Teaches professional mail order technique—not penny-catching schemes. Free details. Nelson Co., 500 Sherman, Dept. J407, Chicago.

SlGNS and showcards easily and expertly painted with Letter Patterns. Many sizes and styles. Write for descriptive folder. John Rahn, B1330 Central Ave., Chicago.

POPULAR Science readers will buy your product or service if you tell them about it here. Write today for rates. Classified Adv. Dept., 353-A Fourth Ave., New York, N. Y.

IF you have some spare room, a basement or garage where you can do light work, we can offer you a profitable proposition casting 5 and 10c novelties, ashtrays, toy autos, etc., for firm of many years standing. No experience necessary as we furnish full instructions with moulds. A rare opportunity to devote spare or full time to profitable work. For details write: Metal Cast Products Co., Dept. E, 1696 Boston Road, New York City.

M.M. earned \$1174 in spare time for exceptional "cellar crop" Snow-King mushrooms! Free book tells if your cellar, shed suitable. We buy crops. United, 3848 Lincoln Ave., Dept. 132, Chicago.

GOOD Paying Business silvering mirrors, plating autoparts, reflectors, bicycles, bathroom fixtures by late method. Free particulars and proofs. Gunmetal Co., Ave. E, Decatur, Ill.

WILL you give us 5% first \$600 you make? Afternoons free! Work home! \$1,000 month reported (exceptional—fulltime). Expect surprise! National-4, BX1240, San Bernardino, Calif.

MEN—Women, operate "Specialty Candy Factory" home. All or spare time. Opportunity for steady income. (Our 31st. year). Booklet free. Ragsdale Candies, Drawer 14, East Orange, N. J.

MAKE Artificial marble. Novelties, floors, pottery. Cement secrets. Brilliant sample 3c. John J. Payn, 945 Grande Vista Ave., Los Angeles, Calif.

MAKE color-glazed concrete pottery, grave-stones, tiles, floors, walls. Basement waterproofing, etc. Booklet, 3c stamp. National Potteries, Minneapolis, Minn.

LIQUID Marble—Colorful, glazed.—Mold, brush, spray! Composition floors, rubber-lastic molds. Particulars Free. Marbleizing Service, Edwardsville, Ill.

127 WAYS to make money, in home or office, business of your own. Full particulars free. Elite Co., 214-A Grand St., New York.

SUCCEED with your products. Make-sell them. Formulas. Processes. Accurate analyses. Catalog Free. P. Thaxly Co., Washington, D. C.

UP to \$25,000 reported using Schemes, tips, opportunities, formulas from "Schemer" Magazine, Alliance, Ohio. Sample 10c; trial six months 30c.

BIG money in perfumes—Make them yourself. Free folder explains. Dr. Abell, Slavin Bldg., Pasadena, Calif.

RECAST old batteries into new. Latest achievements. Battery Laboratories, St. Paul, Minn.

TURN tin cans into money. Instructions 25c. Chaney, 1130 E. 16th St., Jacksonville, Fla.

OPERATE a Collection Agency-Credit Bureau. Very profitable. Permanent. Free folder. Cole Associates, Syracuse, N. Y.

MONEY-MAKING Opportunity. Send 3c stamp. Doctor Finn, 2602-C Gerritsen Ave., Brooklyn, N. Y.

INVENTION Finance Magazine. 80-N Wall Street, New York. For inventors. Free particulars.

RUBBER-Mold making. Plaster casting. Instructions 25c. Kemikon, 179, Park-ridge, Ill.

MANUFACTURE my Motor tune up oil under your label. Real proposition. Schafer, 547 Melrose, Chicago.

WHERE to buy at lowest wholesale prices. Information free. Yorena, Box M-312, Bayonne, N. J.

HANDY men. Earn money home operating Community "Fit-It" Shop, Stanford, Makanda, Ill.

FREE! Opportunity booklet. Moneymaking ideas Galore. Reedy, 2149 Jackson, Chicago.

MOLD making, plaster casting. Foolproof rubber. 24 page instructive catalogue free. Plastic's, 711 Neely, Muncie, Ind.

ESTABLISH own business. Quality products; Excellent proposition. Owen, 830-W Euclid, Detroit, Mich.

AGENTS. Money in Marvex. Information, full sample 25c. Marvo, 831 Ingraham St., N.W., Washington, D. C.

500% PROFIT—Operate America's lowest priced penny merchandise vendors. Fielding Mfg., Jackson, Mich.

MAKE big money using Sawdust. Details 25c. Clement, 43J Arthur, Rochester, N. Y.

24 WAYS to make money, 25 cents. Martin, 506 Main, Lafayette, Ind.

COOKTAIL of M.O. (Stamp appreciated). Publisher, 4 Grant Ave., Allston, Mass.

BUSINESS SERVICE

1000 PERFORATED Stickers 35c; 39 different, assorted colors, Cancel lightly—Special Delivery—Photographs—Handle Carefully, etc. Hundreds other designs. Samples 5c. Arrowprint, 9BPS, Waterbury, Conn.

CAMERAS, PHOTO SUPPLIES

FOLLOW the shrewd buyers who for 30 years have been writing Bass for camera bargains—still or movie. Used Cine-Kodak B, F:3.5 lens, \$22.50. Simplex Magazine, F:3.5 lens, \$22.50. Filmo 75, F:3.5 lens, \$31.50. Foth Derby, F:3.5 lens, \$12.50. Voigtlander Bessa, rangefinder coupled, F:3.5 lens, Compur Rapid shutter, \$48.50. Thousands of bargains listed in free Bass Bargaingram No. 242 Still Cameras—No. 245 Cine Cameras. Write for your copy. Money back guarantee. Bass Camera Company, Dept. SP, 179 West Madison St., Chicago, Ill.

AMATEUR Photographers attention! Improve your hobby of picture taking and learn how to make money with it. Write today for our 40-page book catalog and a sample copy of American Photography, enclosing ten cents for postage. Contains articles and pictures of the world's foremost writers and pictorialists. Camera House 141, 353 Newbury St., Boston, Mass.

OIL coloring photographs a fascinating hobby or profitable business. Learn at home by easy simplified method. Previous experience unnecessary. Send for free information and requirements. National Art School, 3601 Michigan Ave., Dept. 174C, Chicago.

MAKE money in photography. Learn quickly at home. Easy plan. Previous experience unnecessary. Common school education sufficient. Interesting booklet and requirements free. American School of Photography, 3601 Michigan Ave., Dept. 1742, Chicago.

ENLARGER \$1.59. Enlarges eight times size of small negatives. Guaranteed. Paramount Sales Company, 89 Dudley St., Boston, Mass.

CAMERA Repairing. Bellows made to order, shutters repaired. Bellows made to fit, all standard cameras! United Camera Co., Inc., B-1515 Belmont, Chicago.

20% TO 40% discount on films, paper, still or movie cameras. Write: Paramount Co., 327-PS, East 92nd St., New York.

CARTOONING, SIGN PAINTING, DRAWING AIDS

CARTOONING, Sketching, etc.—46 lessons, 600 illustrations, including drawing paper, pens, pencils—\$1.00 complete. Fraba Service, Cashton, Wisconsin.

AMATEUR Cartoonists, earn steady income copying cartoons for advertisers. Adservice, Argyle, Wisconsin.

CHALK TALK STUNTS

LAUGH producing program, \$1.00. Illustrated catalog 10c. Cartoonist Balda, Oshkosh, Wis.

CHARTERS

DELAWARE charters; complete service \$35.00. Submitted forms. Chas. G. Guyer, Inc., Wilmington, Del.

CHEMICALS & APPARATUS

CHEMISTRY Laboratory apparatus and chemicals for industrial, analytical, and experimental laboratories. Complete supply service for students taking correspondence school chemistry courses. Send 3c postage for free 44 page catalog. Dept. M26. Biological Supply Co., 1176 Mt. Hope Ave., Rochester, N. Y.

HANDBOOK for Chemical Experimenters, illustrated, hundreds of experiments, 50c. Experiment booklet, 15c. Chemical catalogue, 5c. Reading Scientific Company, Reading, Penna.

FREE: 40 page catalog of chemical and laboratory supplies for amateur chemists, Wollensak microscopes and supplies, scientific books at big discount. J. C. Winn, Dept. JC-9, 124 West 23 Street, N. Y. C.

FREE Chemistry catalog. Supplies at 5c. Equip. complete laboratory. Kemkit Scientific Corporation, 397B Bridge St., Brooklyn, N. Y.

CHEMISTRY Courses (slightly soiled) at bargain. Particulars. B. Shapereau, 620 E. 8th St., Brooklyn, N. Y.

SPECTROSCOPE for quick chemical analysis \$2.50. McCutting Sons, Campbell, Calif.

JOIN—American Amateur Chemists Society. Descriptive literature free. Haslett, Mich.

CHEMICALS in 5c quantities. Catalog 5c. Fleischer's Laboratories, Medford, Mass.

DOGS, BIRDS, PETS

PUPPIES! All breeds! Reasonable! Information Free! Book 104 photos, descriptions 25c. Royal, Chazy, N. Y.

WHITE Peafowls over one year \$20 pair. Francis Rudkin, Fillmore, Calif.

EDUCATIONAL & INSTRUCTION

WELDING—Electric Arc. Learn quickly by actual practice at Hobart Welding School. Individual instruction at bare cost of materials used. 50c in stamps brings valuable welding lessons post paid and full particulars. Hobart Welding School, Box P-9405, Troy, Ohio.

MEN wanted. Auto-Diesel Mechanics. We pay your railroad fare to Nashville. Let us train you to be an expert mechanic and help you get a good job. The cost to you is small. For free booklet write Nashville Auto-Diesel School, Dept. 269, Nashville, Tenn.

CORRESPONDENCE courses and educational books, slightly used. Sold. Rented. Exchanged. All subjects. Satisfaction guaranteed. Cash paid for used courses. Complete details and bargain catalog free. Nelson Company, 500 Sherman, Dept. J-203, Chicago.

U. S. Gov't. jobs pay up to \$40. a week to start. Get ready for next examinations; railway postal, rural carrier, mail carrier, office help and others. Free book tells how you may qualify. Write quick. Patterson School, Dept. P. S., Rochester, N. Y.

AIR Conditioning—Electric Refrigeration. Rapid growth creates big demand for trained men. Earn up to \$35-50 weekly. Write for Free facts. Utilities Engineering Institute, 404 North Wells, Dept. 309, Chicago.

USED Correspondence Courses and educational books sold or rented. Inexpensive. Money-back guarantee. Write for free catalog listing 4000 bargains. (Courses bought.) Lee Mountain, Pisgah, Ala.

LEARN Telegraphy: Opportunities now available to beginners due to new railroad retirement act. Expenses low. Catalog Free. Dodge's Institute, Harmon St., Valparaiso, Ind.

TOOL-Dismakers—Apprentices—Students. Boom coming get set with "The Shopman's Trigonometry", new, different, \$1.00. Clarence J. Turcotte, Box 823, Mt. Morris, Mich.

CLAIM Adjusting. Excellent pay. Investigate tragic accidents, fires; outwit fraudulent claimants. Burns School, 311 Morewood, Pittsburgh, Pa.

GOVERNMENT Jobs. Men, women. Start \$105-\$175 month. Pay for course after appointment. National Institute, Dept. C, Creston, Iowa.

MEN-Women. Get U.S. Government jobs. \$105-\$175 month. Try next examinations. Particulars free. Franklin Institute, Dept. G35, Rochester, N. Y.

WILL Sacrifice Lifetime scholarship to Coyne Electrical School of Chicago. George Pabst, Route 1, Box 109, Brush, Colo.

LEARN Auto Finance business. Complete Course \$5.00. Free particulars. Nebraska Finance Co., Lincoln, Nebr.

TURN muscles into cash. Get health that leads to wealth. Knoff, 21548B North 52nd St., Milwaukee, Wis.

ELECTRICAL SUPPLIES & EQUIP.

AUDEL'S Handbook of Electricity. For Engineers, electricians, students and all interested in Electricity. A quick, simplified, ready reference, giving complete instruction and practical information. Easy to understand. A reliable authority and a Handy Helper that answers your questions. 1340 pages. 2600 illustrations. Price \$4.00. Postpaid. Money back if not satisfied. Theo. Audel, Publishers, 49 West 23 St., New York.

ALTERNATING Current Bargains. $\frac{1}{2}$ horse, 3450 speed, repulsion induction motors \$10.50, 500 watt, alternating generators \$22.50. Butler Electric Co., 1885 Milwaukee Ave., Chicago.

HEALTH Lamp: Dual Ray—Ultra Violet Infra Red. Promotes Sun-Tan Vitamin "D". Automatic AC-DC current, \$3.90. Details. Beyer Mfg., 4515-C Cottage Grove, Chicago.

FLUORESCENT AC Daylight lighting for desk; office; windows; home. Latest sensation. 50% Discount; literature Free. McGee Radio, E-20, Kansas City, Mo.

TRANSFORMER Laminations cut to your specification. 15c lb. Nothelfer Winding Laboratories, Trenton, N. J.

ALNICO Magnets—Sample 15c. Circulars 3c. Terry, Central Station 781, Toledo, Ohio.

ENGINES, MOTORS, ETC.

BARGAIN $\frac{1}{2}$ HP. rebuilt motors, 60 cycle, 1 phase, 110 volt, 3600 rpm., like new, guaranteed. \$8.25. Send check to Erie Electric Motor Co., 120 Church St., Buffalo, N. Y.

BARGAINS—Welders, electroplating, motor generators, guaranteed, liberal terms. Write Hobarts, Box P-9404, Troy, Ohio.

ALTERNATING, $\frac{1}{2}$ horse, 110 volt, induction motors. Guaranteed, \$7.25. Wilnot Auto Supply, 2247 St. Paul Ave., Chicago.

LOWEST prices gas motors, airplane, boat, accessories, Catalog 5c. Selley, 1375-PS Gates Ave., Brooklyn, N. Y.

FARMS, OTHER REAL ESTATE

129 AC., equipment, neat bldgs. Owner lived well here for 22 yrs., includes team, cattle, machinery, hay, etc.; 9 rms. & hardwood floors, 40x60 barn, handy village & lake; half cost at \$2000, terms arranged; pg. 6 Free catalog 1400 bargains. Strout Realty, 255-ZB 4th Ave., N. Y. City.

GOOD Farms available. Washington, Minnesota, Idaho, western Montana, Oregon. Dependable crops, favorable climate. Write for impartial advice, literature and list of typical bargains. Specify state. J. W. Haw, 120 Northern Pacific Ry., St. Paul, Minn.

40 ACRES, near White River, unimproved; poultry land, \$175; \$5 down, \$5 monthly. Free list and literature. Hubbard, 269 Grossman Bldg., Kansas City, Kan.

FIELDGLASSES, TELESCOPES & MICROSCOPES

TELESCOPES. Everything for the amateur astronomer. Kits \$3.50 up. Mirrors, prisms, lenses. Send 10c for catalog. American Telescope Laboratories, Inc., 5870 Hollywood Blvd., Hollywood, Calif.

ASTRONOMICAL Telescopes, binoculars, cameras, microscopes; bought, sold, repaired. Send 10c for list of instruments desired. Rasmussen, Box 294, Amsterdam, N. Y.

MICROSCOPES, slide making supplies, reagents and stains. Send for free circular M38. Biological Supply Co., 1176 Mt. Hope Ave., Rochester, N. Y.

TELESCOPES. Microscopes, Binoculars; 1940 bargain catalog free. Brownscope Co., 5 West 27th St., New York.

FOR THE HOME

SLIP-LOK Holds door in place when door is opened to desired position. Have you a bedroom or bathroom door that swings open or shut; that just won't stay put? Slip-Lok will hold it securely in place. Prevents knob from striking wall. Nothing to scratch the floor or tear the rugs. Easily installed with household tools. 50c postpaid. Finishes brass, nickel, and black. Slip-Lok, Inc., 53½ West Huron St., Pontiac, Mich.

A-B Venetian Blind Supply Co.—Slats, tape, cord, hardware, 59 Walker St., New York City.

FOR INVENTORS

"WHEN and How to Sell an Invention"—helpful, 24 page booklet gives you preparation steps necessary to commercialize your ideas and six basic approaches to use in selling your invention. Information vital to every inventor. Get your copy free. Victor J. Evans & Co., 572K Victor Bldg., Washington, D. C.

ATTENTION Inventors! Old established patent licensing company doing national business is willing to finance the exploitation of worthwhile patents. Our fee is fair compensation from proceeds only. Address International Industrial Consultants Corporation, Fidelity Bldg., Baltimore, Md.

WE build models which "put over" your idea. Complete engineering service, developing and designing. We market and manufacture in any quantity. Write for bulletins. R. & S. Engineering Co., Dept. BF-9, 17 East 42nd St., New York City.

INVENTORS—Write for my free booklet "How to Make Money From Your Inventions". William H. Holzinger, Registered Patent Attorney, 208 N. Wells St., Chicago.

INVENTORS: Unpatented inventions now salable with positive safeguards under patent laws. New, low-cost procedure. Complete details, free. American Patents Corporation, Dept. 12, Washington, D. C.

WE locate buyers meritorious patented, unpatented inventions. If will sell, reply immediately. Descriptive booklet, references, free. Invention Reporter, 3A-11236 South Fairfield, Chicago.

INVENTORS: Send for free copy my 72-page book on patents. Reasonable terms. Prompt action. Confidential, personal service. L. F. Randolph, Dept. 768, Washington, D. C.

CASH or Royalty—Quickly, Inexpensively for your unpatented invention. A service that's different; literature Free. Mason, 1033 East Eleventh St., Oakland, Calif.

FREE to inventors! An amazing book which gives "inside" on inventing for profit. No cost. No obligation. Crescent Tool Co., Dept. PSZ-SA, Cincinnati, Ohio.

HAVE you a sound, practical invention for sale, patented or unpatented? If so, write Chartered Institute of American Inventors, Dept. 3-A, Washington, D. C.

INVENTORS—Registered Patent Engineer offers a complete Patent and Sales service. Est. 1916. Starck, 333 Wells Bldg., Milwaukee.

CASH for practical ideas and inventions. Mr. Ball, BB-9441 Pleasant, Chicago.

FORMULAS, PLANS, ETC.

THIS Ad gets attention! So will yours—if you use White Space as shown here. Added cost is low! For details, write to Classified Adv. Mgr., Popular Science Monthly, New York, N. Y.

SINGLE-Ingredient Formulas. Interesting information free. C. Kinford, Wayne, Penna.

THAXLY Formulas for successful products. Accurate analyses. Catalog free. P. Thaxly Company, Washington, D. C. 10,000 FORMULAS, recipes, trade secrets, processes, etc., \$1.00. Over 900 pages. Craft Shop, 800-172 North Clark, Chicago.

FORMULAS—Latest, Best, Analysis. Literature Free. E-Belfort, 4042 N. Keeler, Chicago.

FORMULAS. All kinds. Guaranteed. Catalog free. Kemico, 500, Parkridge, Ill.

GAMES—ENTERTAINMENT

UNO—The new fascinating educational, all American family game played with the states. Colored map included. Price 25c. Satisfaction guaranteed. Agents Wanted. The Uno Game Co., Box 205, Kenosha, Wis.

628 PAGE Catalog. 9000 Novelties, puzzles, tricks, hobbies, guns, novelty jewelry, radios, cameras, etc. 3c. Johnson Smith, Dept. 511-Y, Detroit.

HELP WANTED

SALARIED Positions: \$2,500 yearly and up. Let us try to get one for you; small cost. Write for valuable information No. 26A. Executive's Promotion Service, Washington, D. C.

M.M. earned \$1174 in spare time for exceptional "cellar crop" Snow-King mushrooms! Free book tells if your cellar, shed suitable. We buy crops. United, 3848 Lincoln Ave., Dept. 133, Chicago.

HIGHGRADE SALESMEN

FREE Trial to customers—Sells itself! Revolutionary loud speaking Inter-Communication System. Talk privately, back and forth, to one or any number of stations, even 2,000 feet away. Any station originates calls. One electrical connection. No servicing. Easily installed. Guaranteed. Technical experience unnecessary. Two-minute demonstration. Thousands prospects, factories, offices, automobile dealers, lumber yards, restaurants, etc. We carry the accounts. New low price. Men earning high as \$150 week. Protected territory available. Free demonstrator offer. Inter-Communication System of America, 2440 Lincoln Ave., Dept. 405, Chicago.

ADVERTISING Book Matches offer liberal earnings—full, spare time. Experience unnecessary. Factory direct. Low prices for fine quality, quick deliveries, help get orders; Faster repeats. All business firms prospects. Free outfit, instructions. American Match & Printing Co., Dept. 79, 4822 South Trumbull Ave., Chicago.

MAKE more money with Red Comet fire control products. Low prices. Proved seven years. Splendid sales outfit free. Some good territory open. Exclusive. Write quick, 744 Red Comet Building, Littleton, Colo.

CHRISTMAS Leaders! 21 piece Flash assortment 15c; 50 imprint folders 25c; 25 religious imprints 25c; 100 piece Gift wrap box 25c. Samples \$1.00 postpaid. Illustrated catalog Free! Elsko, 440 North Wells, Chicago.

SALESMEN: America's finest sideline. 40% commission daily. 1000 fast selling repeat items. Every business uses and must buy. No investment now or ever. Sales portfolio free. Willens, 2130 Gladys, Dept. AF, Chicago.

YOUR ad in this Classification will reach productive sales-getters for your products or services. Rates on request. Popular Science Classified, 353 Fourth Ave., New York, N. Y.

BLADES—Big profits. Best quality. Factory prices. Postpaid. Ace Blades, Buffalo, N. Y.

ELECTRICIANS, Salesmen. Inexpensive Fire Alarms for any building. Schroeder, 1219 South Sixteenth, Milwaukee, Wis.

HOBBIES

628 PAGE Catalog. 9000 Novelties, puzzles, tricks, hobbies, guns, novelty jewelry, radios, cameras, etc. 3c. Johnson Smith, Dept. 511-Z, Detroit.

KNIFE Throwing secrets exposed! Illustrated book tells all. \$1.00 postpaid. F. Dean, 1294 E. San Fernando, San Jose, Calif.

FIFTEEN different cactus plants \$1.00. Grow anywhere. Eulalia Turners, Azusa, Calif.

HOME CRAFTSMEN

22 LAWN Ornament patterns 25c. Other patterns: 15"-20" high; Dutch girl, Dutch boy, pirate, bull terrier, Mexican girl, Mexican Boy, dwarf, Penguin, flower girl, 10c each; 3 for 25c. 25 novelty patterns 30c. All 56 full size patterns \$1.00 postpaid. Strother, Box 383-BK, Belington, W. Va.

LEATHERCRAFTSMEN: Send 10c for handbook and catalogue of tools and supplies. E. A. Sweet Company, Inc., Leathercraft Div., Dept. S-3, 143 State St., Binghamton, N. Y.

GET Free Leathercraft instruction pamphlets, prices of leathers, tools, projects. Make extra money—gifts. Leather samples 5c. Wilder & Co., 1038 Crosby, Dept. A-9, Chicago, Ill.

628 PAGE Catalog. 9000 Novelties, puzzles, tricks, hobbies, guns, novelty jewelry, radios, cameras, etc. 3c. Johnson Smith, Dept. 511-W, Detroit.

PATTERN Catalog finely illustrating 250 plywood Novelties, silhouettes, lawn ornaments, Decal transfer decorations. Also other lines. Wo-Met Shop, Ashburn, Ga.

80 PATTERNS, 20 lawn ornaments, 20 silhouette, 20 novelties, 20 lawn ornaments, 30c each set, all for \$1.00. Modern Woodcraft, Saginaw, Mich.

VENETIAN Blinds—Supplies; Machinery; Wholesale Catalog 10c. "Manufacturing" Booklet, \$1.00. "Roberta", Box 260, Gloversville, N. Y.

WE specialize in inlaid borders and fancy veneers for craftsmen. Samples and list 10c coin. Beck Co., P.O. Box 255, New Albany, Ind.

20 NOVELTY patterns, 25c. 15 lawn ornament patterns, 20c. Wayne Gorman, Box 1272-A, Amarillo, Texas.

INVENTIONS WANTED

SIMPLE, practical inventions wanted by manufacturers, patented or unpatented. For information write Chartered Institute of American Inventors, Dept. 3-C, Washington, D. C.

WANTED—Meritorious patented, unpatented inventions. Booklet, references, free. Invention Reporter, 3B-11236 South Fairfield, Chicago.

SMALL inventions wanted by manufacturers. I'll help you sell your invention. Write for free circular. S. Hull, 7829-M Euclid Ave., Cleveland, Ohio.

INVENTION Finance Magazine, 80-N Wall Street, New York. For inventors. Free particulars.

INVENTIONS Promoted. Patented or unpatented. Write Adam Fisher Co., 183-A Enright, St. Louis, Mo.

CASH for inventions—Patented or unpatented. Mr. Ball, BC-9441 Pleasant, Chicago.

LEGAL DIRECTORY

MEXICAN Legal Matters. Wm. A. Cocke, Amer. Atty., El Paso, Texas.

MACHINERY, TOOLS & SUPPLIES

LONMOPower attachment converts any hand lawnmower into complete power lawnmower economically. Agents wanted. Lonmopower, 345 North Crawford, Chicago.

LATHES—We have a few bargains in slightly used lathes, 9" to 16" swing. Write for July Blue List, South Bend Lathe Works, 455 E. Madison St., South Bend, Ind.

MAGIC TRICKS, PUZZLES, JOKER NOVELTIES

WORLD'S largest professional magic shop keeps you in touch with latest tricks. To receive mailings send 25¢ for 1940 catalog. Holdens, P-220 W. 42nd St., New York.

AMAZE and Mystify! Be Popular! Magic easily learned. Illustrated catalog 500 startling tricks 10c. Lyle Douglas, Station A-1, Dallas, Texas.

628 PAGE Catalog. 9000 Novelties, puzzles, tricks, hobbies, guns, novelty jewelry, radios, cameras, etc. 3c. Johnson Smith, Dept. 511-U, Detroit.

JOIN Magicians! Fraternity! Free tricks! Monthly magazine, sample 10c. International Magicians, Mt. Morris, Ill.

MANUFACTURING

INVENTIONS—Manufactured in any quantity at low cost by old-established reputable company. No branches anywhere. Stampings, metal specialties, dies, models, etc. Free estimates. Free catalog. Crescent Tool Co., Dept. PSY-SA, Cincinnati, Ohio.

AN individual service for inventors. Developing models—manufacturing—dies—tools—special machinery. H. & H. Tool & Mfg. Co., 308 E. 3rd St., Cincinnati, Ohio.

INVENTIONS developed and manufactured. Send us your ideas. Model Engineering, Osgood, Ind.

MISCELLANEOUS

CORRESPONDENCE courses and educational books, slightly used. Sold. Rented. Exchanged. All subjects. Satisfaction guaranteed. Cash paid for used courses. Complete details and bargain catalog Free. Nelson Company, 500 Sherman, Dept. J-204, Chicago.

DRUG Sundries, specialties, supplies, etc. mailed direct by manufacturer. Send for free mail-order catalog, saving 75%. Mail-Order, Dept. 5A, Box 231, Hamilton, Ontario.

TREASURE Finder locates hidden money, lost treasure, minerals, pipes, etc. Build yourself. Instructions 25c. Craft Shop, 800-181 North Clark, Chicago.

ABRASIVSTROP! 250,000! Gillette Months! Komfort. Booklet? B-ello; Gardner, Mass. (Rexalls).

SO-CALLED Bergman's Instrument \$5.00 Postpaid. 30 days free trial. Henry Bergman, Box 70-B, Springfield, Mo.

FREE literature how to locate buried treasure and minerals. Fisher Laboratories, Palo Alto, Calif.

STOVE Linings—Furnace; Iron. Fits all. Patented. Circulars Free. Benjamin Co., Granite City, Ill.

PRETTY Girl photos, books, novelties. Catalog 10c. E. G. Specialties, P. Carnegie, Penna.

VEST pocket bill fold, dime. Rommel, R. 2, Troy, N. Y.

MODELS & MODEL SUPPLIES

MODEL Castings—estimates; send stamped envelope. Casto, B948 Dearborn Detroit, Mich.

ENGINE Catalogue castings, supplies, 25c. Howardco, P-2417 North Ashland, Chicago.

ZOOM—Model Kits, airplanes, boats, racers, gas motors. Complete stock—send 10c for big catalogs. Box 617, Dayton, Ohio.

THOUSANDS ship fittings, hundred kits, catalog 10c. Polk's, 429 Seventh Ave., New York.

MONEY MAKING OPPORTUNITIES

MONEY can be made repairing scales. For information regarding instructions on repairing send stamped envelope Ackerman Scale Repairing Instructions, (Copyright 1940), Box 1653, Charlotte, N. C.

THIS AD gets attention! So will yours—if you use White Space as shown here. Added cost is low! For details, write to Classified Adv. Mgr., Popular Science Monthly, New York, N. Y.

BE a professional scrapbooker. Big fees. Unlimited opportunities. Can be done at home. No competition. No capital needed. Write to Scrapbookers Guild, 59 Park Place, New York, N. Y.

EARN money addressing envelopes, circulars, typing. Information 10c. None free. Ace-PSMX, 316 Empire, Birmingham, Ala.

MAILORDER opportunities, plans, big mails, publication, imprints. Harvey Teeple, Decatur, Ind.

AMATEUR Cartoonist, earn steady income copying cartoons for advertisers. Ad-service, Argyle, Wisconsin.

DOUBLE your income! 300 moneymaking plans, 40,000 words, 25c coin; postpaid. D. Janbard, Box 195, Long Beach, Calif.

EARN money taking magazine subscriptions. Details Free. New York Circulation, 30 Church, New York.

YOU'LL like resilvering mirrors, reflectors, making chipped glass nameplates, signs. Write Sprinkle, Plater, 920, Marion, Ind.

"RAISE Earthworms for profit." New, interesting, home business. Bureau Zoological Research, 106P Broadway, Peoria, Ill.

FREE Formula. Successful lube reclaiming. Boisset, Box 483, New Orleans, La.

QUICK Money, 2 way proposition. Write now. Kohne, 506 W. 45th, Chicago.

MOTION PICTURE & SOUND EQUIPMENT

NEW Sateen screens, 9'x12' \$15.00. Pathe \$55.00 hand generator, special \$9.50. Drying drum complete for 1000' 16mm, 500' 35mm, \$27.00 Acme portable 35mm projector, 1000', motor driven, complete \$25.00. Powers heads, also complete outfits, \$10.00 up. Universal Camera, less lens, 2-400' internal magazines \$33.00, Victor "25" 16mm projector, complete, \$149.50. Odd 400' silent 16mm films, \$1.95; soundfilm, \$2.95. Pathex 9½mm \$18.00 camera, f:3.5, special \$2.99; film \$1.49 with processing. Trades accepted, bought. Mogull's, 66 West 48th, New York.

WRITE for new large two color 1940 catalogue nationally advertised movie cameras, projectors, films, accessories. Payments low as \$2.50 monthly. Don Elder's Home Movies, G-739 Boylston St., Boston, Mass.

GUARANTEED 24-Hour 8mm—16mm reversal Processing. Bulk film lists for stamp. Eso-S, 3947 Central, Kansas City, Mo.

OUTDOOR Film 100 ft. 16mm \$1.98. 25 ft. double 8mm 98c. Processing included. Free bargain lists. Home Movies, Box 216S, Easton, Pa.

ART Films. Sample, dime; catalog free. Cine, 2443 Gunnison, Chicago.

VARIETY art 8-16mm—10c for sample and list. Rio, Box 159-P, Hornell, N. Y.

ART Films, sample 10c; lists free. Goodwill Company, Jackson, Tenn.

MOTORCYCLES, BICYCLES & SUPPLIES

MOTORCYCLE, parts, accessories. Most complete stock. New & used. We specialize on Mail orders. What do you need? 35 page catalog 10c. Whitman Motorcycle & Supply Co., 405-9 Southwest Blvd., Kansas City, Mo.

ALLOY Pistons \$3.00; Indian, Harley, Henderson, Excelsior, Cleveland. New and used parts for less. Cylinder grinding. Catalogue and wings pin 10c. Ballak, 811 No. 9th, St. Louis, Mo.

MOTORCYCLES, reconditioned. New, used, parts and accessories. All makes. Large stock. Bargains. Illustrated catalog, 15c. Indian Motorcycle Sales, Kansas City, Mo.

MOTORCYCLE bargains, lowest prices, bargain sheets for stamp. Motorcycle accessories. Rochester Harley Davidson Corp., 131 W. Main St., Rochester, N. Y.

BICYCLE Motor Push-a-Bike outboard motor complete with pneumatic tire ready to attach. Dept. C, Richburn Co., Aurora, Mo.

MOTOR Scooter, engines, parts. Literature, 6c. Goldi Motor Scooter Co., Niles, Mich.

SCOOTER Bike—Build from discarded materials. Instructions, plans, 25c. Craft Shop, 800-178 North Clark, Chicago.

MUSIC, MUSICAL INSTRUMENTS

MUSIC composed to words. Rhyming Pamphlet on request. Phonograph recording of completed song. Send poem. Keenan's Studios, Dept. PS, Box 2140, Bridgeport, Conn.

PHONOGRAPH Records 10c. Catalogue. Paramount ME-358 East Market, Wilkes-Barre, Penna.

TWENTY Late phonograph records, only \$1.00. (Shipping charges collect). Paul, Oswego, Ill.

SONG Poems wanted. Free examination. McNeil, Master of Music, 510-PS South Alexandria, Los Angeles, Calif.

WANTED! Lyrics, melodies for songs. We arrange, publish, sell. Superior Song Studios, Passaic, N. J.

LEARN Swing piano! Postal brings free folder. Christensen, 751 Kimball Hall, Chicago.

OLD GOLD, WATCHES, PRECIOUS STONES

ELGIN, Waltham watches from \$3.50. Make big money. Send for free watch and jewelry catalog. Plymouth Jewelry Exchange, 163-P Canal St., New York.

GEMS, Agates, minerals, 20 rough gemstones \$1.00. Catalog free. Hill, Route 7-K, Salem, Oregon.

OPTICAL

LENSES duplicated (Toric, first quality) Single vision \$1.95; Kryptok Bifocal \$2.95; Rose color \$1.00 additional. Arndt's, Aberdeen, S.D.

BROKEN Lenses duplicated single vision white \$1.00; Kryptok Bifocals \$2.00 (Except corrected curves). Speedy Optical, 5135 Blackstone, Chicago, Ill.

PATENT ATTORNEYS

PATENTS: Take first step to protect your invention—without cost. Send today for "Record of Invention" form—and new "Patent Guide for the Inventor" containing instructions on how to patent and sell inventions; details of search service; easy payment plan. Write today. See page 19 for further information. Clarence A. O'Brien, Registered Patent Attorney, Dept. OJ2B, Adams Bldg., Washington, D. C.

"INVENTOR'S Guide," full information about patenting, selling inventions. Free. Patent Attorney-Engineer Frank B. Ledermann, 154 Nassau St., New York.

INVENTORS: Write immediately for two free books, "Patent Protection" and "Selling an Invention." Explain many interesting points to inventors. "Evidence of Invention" form enclosed. Reasonable fees, forty-two years' experience. Avoid risk of delay. Address: Victor J. Evans & Co., Registered Patent Attorneys, 571-K Victor Bldg., Washington, D. C.

INVENTORS Get my new Free book. Use my personal confidential patent service. Send for free facts on patenting your invention. Also suggestions on financing a patent application. Reasonable fees. Deferred payments arranged. Write Hugh E. McMorro, Registered Patent Attorney, 143-A Barrister Bldg., Washington, D. C.

INVENTORS: Before disclosing your invention to anyone send for Form "Evidence of Conception": "Schedule of Government and Attorneys' Fees" and instructions. Sent free. Lancaster, Allwine & Rommel, 413 Bowen Building, Washington, D. C.

PATENTS—trade marks. Preliminary advice, book and disclosure form free. Personal service. Irving L. McCathran, 1050 International Bldg., Washington, D. C., Registered Patent Attorney.

INVENTORS: Send for free copy my 72-page book on patents. Reasonable terms. Prompt action. Confidential, personal service. L. F. Randolph, Dept. 340-A, Washington, D. C.

WRITE for Free Patent booklet describing my Special Payment Plan for inventors. Eugene Purdy, Registered Patent Attorney, 1806 International Bldg., Washington, D. C.

PATENTS—Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 724 Ninth St., Washington, D. C.

PATENTS

WE Successfully sell inventions, patented and unpatented. Write us, if you have a practical, useful idea for sale. Chartered Institute of American Inventors, Dept. 3-B, Washington, D. C.

PATENTS FOR SALE

SEMI-PRESSURE cooker & roaster. Most complete answer to the cooking problem. J. Stevens, Valley City, N. D.

PERSONAL

HOLLYWOOD land of opportunity. Home of motion pictures, radio center. Talented and ambitious people needed, before you come, know the facts, write Hollywood Talent Guide, P-6411 Hollywood Blvd., Hollywood, Calif.

WIN prize money. Booklet, "Successful Contesting," shows how, 10c postpaid. Bulletin listing \$100,000.00 prizes included. World Publishers, 4515-L Cottage Grove, Chicago.

SINUS Trouble. If a victim of Sinus or Catarrhal Infection, write National Laboratories, Benj. Franklin Station, Washington, D. C.

GOOD eyesight without glasses or apparatus. Complete illustrated course \$1.00. Satisfaction guaranteed. Eyesight Improvement, Hamilton, Ohio.

PURCHASE drug sundries at tremendous saving without embarrassment. Send for our Special no cost offer. Sherell Products, Box 54-A, Rochester, N. Y.

ANY question answered on any subject, \$1.00. Absolute satisfaction guaranteed, or no charge. Strictly confidential. Write—Dr. Smith, Box 87, Clinton, Mass.

LEARN Ventriloquism, 3c stamp brings particulars. Smith, Room 775, 801 Bigelow, Peoria, Ill.

WANTED Lecturers, musicians, impersonators, humorists, magicians. Horace Coats, Borden, Ind.

PHOTO FINISHING

THE Photo Mill. Immediate Service! No delay! Eight-exposure roll developed, carefully printed and your choice of two beautiful 5 x 7 double weight professional enlargements, one tinted enlargement, or eight reprints for 25c coin. Reprints two cents each. Highest quality guaranteed. The Photo Mill, Box 629-10, Minneapolis, Minn.

ROLL Developed — 16 guaranteed prints, two coupons on enlargements, 25c. Smart Photo, Winona, Minn.

TECHNIFINISH—35MM. 36 exposure rolls including "Mercury" fine grain developed and perfectly enlarged to 3" by 4" glossy prints, 85c. New, exclusive methods and equipment make this low price possible. Cartridge reloaded with Eastman Plus X, 25c. One day service. Satisfaction guaranteed or money back. Write for free mailing bags and information. Technifinish Laboratory, 108-J Lexington, Rochester, N. Y.

ROLLS developed and printed new electric eye way. 8 beautiful, guaranteed, never-fade, dated, deckled edged enlargements. Any 8 exposure roll. All for 35c coin each roll. Extra enlargement coupon Free. Bonus certificate Free. 2-day service guaranteed. Send rolls now to Bostonian Photo Laboratories, 406 Uphams Corner, Boston, Mass.

FINER Finishing specials 25c. 6 or 8 exposure roll developed. Your choice—16 prints or 8 prints with 2 professional enlargements or 8 prints and one colored enlargement. Genuine Moen-Tone Nationally known superior quality. Established 1899. Moen Photo Service, 200 Moen Bldg., La Crosse, Wis.

OVERSIZE Prints. Your roll developed and 8 oversize prints 25c; from 116, 120, or 127 size negatives you receive 4x6 inch prints. All smaller sizes receive 3 1/4 x 4 1/2 inch prints. Reprints 3c each. Overnight service. Pacific Photo Service, Box 666, San Francisco, Calif.

PHOTOGRAPHY for pleasure and profit. Prepare for profitable business or fascinating hobby at home. Common school education sufficient. Write for information and requirements. American School of Photography, 3601 Michigan Ave., Dept. 172C, Chicago.

ROLL Filmachine developed and your choice (1) 8 Finerfotos and 2 professional Bromide enlargements; or (2) 16 guaranteed Finerfotos or (3) 8 Finerfotos and one beautiful oil colored enlargement. 25c. Order by number. Prompt Service. Finerfotos, Box 898-18, Minneapolis, Minn.

ROLL developed. 8 brilliant fadeproof Velox prints and two professional enlargements 25c. 35mm. roll fine grain developed and 36 — 3 1/4 x 4 1/2 enlargements \$1.00. 18 exposures 60c. Overnight service. Young Photo Service, 406-C, Albany, N. Y.

THIS Ad gets attention! So will yours—if you use White Space as shown here. Added cost is low! For details, write to Classified Adv. Mgr., Popular Science Monthly, New York, N. Y.

8 DOUBLE Weight professional enlargements 25c. From rolls up to 116. 35mm. (36 exposures) enlarged for \$1.00 on Double Weight paper. Enlargit, General P.O. Box 121A, New York.

ROLL developed and 8 beautiful enlargements 2 to 6 times larger—deckled edge—high gloss. Any 8 exposure roll 25c coin. Reprint enlargements 3c each. Alden Photos, 258-C Astor Station, Boston, Mass.

FREE Beautiful Album with cellophane envelopes plus roll developed and two sets prints, 25c. Free mailers. Same-day service. Pho-T-Pho, Box 24-G6, Highland Park, Mich.

ROLLS developed, two prints each and two free enlargement coupons, 25c; reprints, 2c each; 100 or more, 1c. Summers' Studio, Unionville, Mo.

ROLLS developed — 8 guaranteed prints plus 2 enlargements, 25c. Reprints 3c each, 30 for 2c each, 100 for \$1.00. Martin Studios, Davenport, Iowa.

TWO beautiful prints from each picture on roll 25c. Twenty years of satisfied customers. Quick service. Lens Photos, Dept. J-9, Janesville, Wis.

ROLLS developed—Two beautiful double weight professional enlargements, 8 Never Fade prints, 25c. Century Photo Service, LaCrosse, Wis.

IDEAL Photos beautifully finished with wide border, deckle edged; 25c per roll of 8 and Free enlargement. Ideal Photos, Box 2255, Paterson, N. J.

8 ENLARGEMENTS—films developed plus 8 enlargements, 25c coin—116 or smaller. Enlarge Photo, Box 791, Dept. PSM, Boston, Mass.

LOOK! Sixteen sparkling neverfade prints per roll, and valuable enlargement coupon, 25c. Modern Studios, LaCrosse, Wis.

YOU get one 5"x7" silk enlargement. Send negative—10c. Rapid Studios, Box 123-E, Villa Park, Ill.

CANDID special: 35 Millimeter rolls enlarged to 3 1/2 x 4 1/2, \$1.00. 18 Millimeter rolls, 60c. 3 1/4 x 4 1/2 reprints, 3c each. Brown Photo Company, 1910-60 Emerson, Minneapolis, Minn.

NEW! Sensational! 1940 style leader 8 exp. roll finished, prints deckled, dated, & in a neat album, plus Valuable Coupons 25c. Triangle Photo Service, Box 402, Oak Park, Ill.

FOR the discriminating amateur. Rolls developed and 2 prints each 25c. Reprints 3c. Superior workmanship. Same day service. Paramount Co., 327 E. 92nd St., New York.

ROLLS developed. Two sets prints plus enlargement coupon, 25c. Reprints, 3c. Over 19 reprints, 2 1/2c. Jones Studios, Davenport, Iowa. "Where the West Begins."

PROMPT Service—Guaranteed work. Two beautiful portrait type doubleweight enlargements, eight neverfade gloss prints, each roll 25c. Dubuque Film Service, Dubuque, Iowa.

AT Last! All your snapshots in natural colors! Roll developed, 8 Natural Color prints, only 25c. Reprints, 3c. Amazingly beautiful! Natural Color Photo, Janesville, Wis.

18 LIFETIME Prints, 2 sparkling Hollywood enlargements each roll 25c. 21 reprints 25c. 100—\$1.00. Finished 3 hours. 25 other bargains. Overnight Studio, Albany, Wisconsin.

FREE Trial—16 sparkling lifetime prints, three lovely Hollywood enlargements and Free Leathertone frame with roll—25c. Overnight service. Lifetone Studios, L-27, Des Moines, Iowa.

ROLL developed 6 or 8 prints including 5x7 enlargement 25c coin; without enlargement 20c coins. Gem Photo Service, Dept. A. 3355 West 63rd, Chicago, Ills.

ONE Print and one free 4x8 enlargement of each of all six or eight negatives on a roll, 25c. Jumbo Laboratories, Box 426, Lincoln, Nebr.

TRIAL roll 10c and this ad. Beautiful deckled album prints. Positively finest finish obtainable. Mailbag, Box 5440-A, Chicago.

CANDID Developing trial—36 exposures enlarged 3x4, including free enlargement coupon—65c. Micrograin Laboratories, N-41, Des Moines, Iowa.

DOUBLE Size prints. 8-exposure roll developed, one print each enlarged to nearly postcard size 25c. Willard Studios, Box 3535R, Cleveland, Ohio.

20 REPRINTS 25c. 100—\$1.00. Roll developed 16 prints 25c. 5x7 enlargements 10c. 3—25c. Nordskog, 58, Maywood, Ill.

PROMPT Service—Quality work; 2 beautiful doubleweight gloss enlargements, 8 guaranteed neverfade prints each roll, 25c. Excel Photos, Dubuque, Iowa.

TWO beautiful professional double weight enlargements, eight lifetime prints, 25c. Prompt—Careful. Film mailers Free. May's Photo Shop, Box 870-AK, LaCrosse, Wis.

35MM DEVELOPED, vaporated, enlarged on 3 1/4 x 4 1/2 deckle-edge paper. Free 5x7, \$1.00. Photo-Hall, Box 12, Kingsbridge Sta., New York City.

ENLARGEMENTS Doubleweight 8x10, 35c; four \$1.00; 5x7, 20c; six \$1.00. Prompt service. Roy-Art Photos, P. O. Box 1702, St. Louis, Mo.

LOOK—Beautiful Tinted enlargement (5x7) and 8 prints, 25c. Pastel. "The Nation's Color Studio," BX 1111P, Des Moines, Iowa.

TRY Clik-Tik Guaranteed Finishing! Double Value—16 prints—Send film 25c. Clik-Tik, Sioux Falls, S. D.

BEAUTIFUL Enlargement from each picture on roll 25c. Cut Rate Photos, Dept. A-6, Janesville, Wis.

GUARANTEED. Film developed, 16 prints, 2 enlargements 25c. 20 prints 25c. Quality Photo, Hutchinson, Kansas.

16 OVERSIZE Deckledged prints and two enlargements, 25c. Owlphoto PS2, Weatherford, Okla.

FREE Snapshot magazine, mailing equipment and price list. H. F. H. Co., Jamaica Plain, Mass.

ROLLS, packs, developed, printed. Enlargement coupon, 25c. Iso Chemical Co., Manitowoc, Wis.

FREE, developing, Free. Eight Prints 15c (Coin). Garrett's, Pittsburg, Kansas.

PROMPT Service! Rolls developed, two Velox prints each negative, 25c. Hensch Studios, Harrisburg, Penna.

ENLARGEMENTS that please. 5x7 3 for 25c. 8x10 3 for 50c. Send negatives, Lee Photos, P.O. Box 2053, Chicago.

SALON Enlargements Mounted (11x14")—from any negative—\$.50. Minifinish, 671 W. 162 St., New York City.

SNAPSHOTS, roll finished 25c (16 prints or eight enlargements). Speedy Service, Box 64-P, Wilkes-Barre, Pa.

5x7 ENLARGEMENTS 10c from your negatives. Film Service, Catlin, Ill.

PLAYS, STORIES, MANUSCRIPTS

WRITERS! I've been selling for others ten years—stories, books, articles (hundred sales own stuff). Offer you professional help (journalism grad., Illinois). Fee: dollar first thousand words, half thereafter, maximum ten. John Kieran, Authors' Agent, 114 Chester Ave., Danville, Ill.

YOUR story ideas built into salable short stories, novels, plays—revised, typewritten, marketed. Tynan Author's Bureau, Rhinebeck, N. Y.

POULTRY & SUPPLIES

DEPENDABLE baby chicks on easy payments, \$3.95 per 100 up. Year-round delivery. Chestnut Hatchery, Box 39, Chestnut, Ill.

PRINTING, MULTIGRAPHING, MIMEOGRAPHING, LABELS

PRINTING cuts made; finest quality, \$1.25 up; Save money, line cuts, halftones, electros, stock cuts, artists; free price list. Riteway, 1465-PSS Broadway, New York.

125 8 1/2 x 11 TWENTY pound bond letterheads and 125 6 3/4 envelopes, \$1.00 postpaid. Benneville, 907 West Roosevelt Blvd., Philadelphia.

HAMMERMILL letterheads, any color, envelopes matching; 30 styles type. Free particulars. Woodruffs', 217-D, Duluth, Minn.

PRINTED Personal correspondence stationery, 200 sheets, 100 envelopes, \$1.25. Weston, 607 8-So., Seattle, Wash.

SEND for free printing price list. Horizon Ptg. Co., 4547 So. Paulina, Chicago.

PRINTING OUTFITS & SUPPLIES

PRINT your own cards, stationery, circulars, advertising. Save money. Easy rules furnished. Print for others, big profits. Junior outfits \$8.25, senior outfits \$16.55 up. Details free. Kelsey Presses, H-8, Meriden, Conn.

HAND presses, type and complete printers supplies. Send stamp for new 52-page catalog. P. Peiffer & Company, 4 Columbia St., Newark, N. J.

BARGAINS, Presses, type. List 3c. Exchange, A-27, 222 Columbus, Meriden, Conn.

INEXPENSIVE 6x9 printing press. Details Free. Novelty Shop, Downsville, La.

PROFITABLE OCCUPATIONS

HUNCH!—Newly patented compact pocket piece. No tips or forms needed. Play your Hunches for horse races, dog races, lotteries, numbers games. One dollar postpaid. Hunch Products, Dept. S, 219 E. Washington St., Los Angeles, Calif.

RAISE Rabbits and Cavies for us. Full details. Catalog, contract and magazine 10c. Or send 25c for book, catalog and year's subscription to Small Stock Farmer Magazine. Stahl's, Box 11, Holmes Park, Mo.

M. M. earned \$1174 in spare time for exceptional "cellar crop" Snow-King mushrooms! Free book tells if your cellar, shed suitable. We buy crops. United, 3848 Lincoln Ave., Dept. 116, Chicago.

AUTO Body and fender work—Learn at home in 4-6 weeks; important trade with good money-making opportunity. Atlantic, 718-23rd Ave., Oakland, Calif.

POSITIONS Abroad—Romance, opportunity, adventure. List of 86 companies with foreign branches, only \$1. Send now! X. Julius, Amarillo, Texas.

50 TESTED ways to earn money with a Camera, 15c. Craft Shop, 800-184 North Clark, Chicago.

RADIOS, SUPPLIES & INSTRUCTION

RADIO engineering, broadcasting, aviation and police radio, servicing, marine and Morse telegraphy taught thoroughly. All expenses low. Catalog free. Dodge's Institute, Poplar St., Valparaiso, Ind.

RADIOS—\$7.95 up; kits—\$3.95 up. Complete. Ready to wire, 5-10 tubes. Save 50%. Catalog—Free. User agents wanted. Marco-EP, Kansas City, Mo.

REPAIR your radio yourself—Expert diagnosis and directions—50c. Radio Clinic, 1327 W. 112th, Cleveland, Ohio.

RARE COINS

WILL pay \$10.00 each for certain Lincoln pennies! Indianheads \$150.00; dimes \$700.00. Catalogue 10c. Federal Coin Exchange, Columbus, Ohio.

FREE! Foreign coin, banknote, and large illustrated coin catalogue. Send 4c postage. Coin approvals sent. Tatham Coinco, Springfield-D50, Mass.

COMMEMORATIVE 1/2. Columbus, Lincoln, Stone-Mountain, Cleveland, \$1.00 each. Retail catalogue 10c. Norman Shultz, Salt Lake, Utah.

LARGE 28 page retail coin Catalogue 5c. James Randell, 37 West Van Buren, Chicago.

RAZOR BLADES, SHAVERS

200 FAN Blades for Gillette or 100 for Gem Razor \$1.00 Postpaid. Perfection guaranteed. Main Blade, Box 6555, Los Angeles, Calif.

RUBBER STAMPS

SIGNATURE Rubber Stamp \$1.50. Gold-worthy Stamp Works, 17 Richmere Rd., Mattapan, Mass.

3 LINE Cushioned 25c; 2 stamps 40c. Print-rite, Wauwatosa, Wis.

CUSHIONED, 2 lines 25c. 3-35c. Ours are better! Ad-Crafts, LaCrosse, Wis.

SONGWRITERS

WANTED: Original poems for musical setting. Publication, radio, recording service. Richard Brothers, 146 Woods Bldg., Chicago.

WANTED. Poems, to be set to music. Submit for consideration. Transcription records made. Keenan's Studio, PS, Box 2140, Bridgeport, Conn.

FREE. Inspiring booklet describing song-writing opportunities. Allied Music, Dept. 5, Box 507, Cincinnati, Ohio.

SONG Poems wanted. Free examination. McNeil, Master of Music, 510-PS South Alexandria, Los Angeles, Calif.

SONGS; Poems bought—published—Royalty basis. Free advice. Metro-Melody Music Publishers, San Francisco.

PIANO Parts to three poems \$18.00. Songland, "40PSM9", Thomaston, Maine.

SPORTING GOODS, GUNS, FISHING TACKLE, ARCHERY

GUNSMITHING. Restocking Guide (24 pages). Free. Invaluable for amateur, professional gunsmiths, Home craftsmen, shooters; Exclusive, complete information, illustrations, Walnut stocks, Blanks, gunsmith tools, remodeling, actions, blueing, checkering tools. Limited supply. Write America's Great Gun House. Stoeger Arms Corp., 507 Fifth Ave., New York, N. Y.

ARCHERY: Ideal sport and recreation. Complete instruction book, 50c. Catalog free. Chester Brown, 617 South State, Chicago.

ARCHERY Kits complete, everything that's needed. Catalog. Krons-Noble Co., 910 43rd St., Kenosha, Wis.

STAMP COLLECTING

FREE—Entire issue of "Famous Americans"—This new issue of United States commemoratives consists of 35 stamps to be issued at the rate of 5 stamps every month. We will send Absolutely Free this entire issue to collectors on our active approval mailing list. We'll also send at once for only 10c an attractive, specially prepared album for this magnificent issue, which contains, besides spaces for each stamp, the history and achievements of the 35 great Americans. Send 10c for that album today. You will receive it by return mail together with a splendid approval selection. Globus Stamp Co., 268 Fourth Ave., New York City, Dept. 217.

UNITED STATES; special to new approval applicants: fourteen different Postage Dues, 10c; twenty different Revenues, 10c. Southern Stamps, Box 70, Miami, Fla.

80 DIFFERENT, including airmails, commemoratives, pictorials, etc., 3c to approval applicants. Hunziker's, Box 225-NS, Minneapolis, Minn.

"HORRORS Of War" Packet! Thrilling stamps picturing horrible war scenes: Ukraine "death stamp" depicting "Grim Reaper"; Azerbaijan (food for dead men!); Portugal (slaughter of an army); Bulgaria (soldier with drawn bayonet); Norway (battle scene one thousand years ago); also modern nations at war—China, Poland, Mongolia; many others. Extra for promptness: Pocket stock book and scarce set from Asiatic war countries, cataloging over 50c! All for 5c to approval applicants! Jamestown Stamp Co., 237 Wellman Bldg., Dept. 5, Jamestown, New York.

GIANT packet 200 all different from Africa, South America, Asia, South Sea Islands, etc. Includes world's smallest stamp; triangle and diamond-shaped stamps; animal stamps. Nicaragua "Will Rogers" airmail; many others. Also packet 17 different United States (cataloging 50c); all obsolete, including \$4 denomination, commemoratives, etc. Total catalogue price over \$5.00! Everything for only 5c to approval applicants! Mystic Stamp Company, Dept. 55-N, Camden, New York.

FREE! The Stamp Finder! Send today for big new edition, fully illustrated, enabling you instantly to identify all difficult stamps! Also fine packet strange, fascinating stamps from Bosnia-Herzegovina, Monaco, Patiala, Cyprus, etc., including maps, ships, animals and strange scenes. All free to approval applicants enclosing 3c postage. Garcelon Stamp Co., Box 918, Calais, Maine.

COLLECTORS—Superb United States stamps including airmails, commemoratives, postage on approval. Freshly filled, correctly numbered booklets. Harvard Stamp Co., 318 Harvard St., Brookline, Mass.

SELANGOR Perak, Albania, Haiti, Bhopal, Palestine, Johore, Manchukuo, Congo, Kadhah, Cochin, Kookaburra-bird and 200 different stamps only 10c with approvals. Reich Stamp Co., 4647 Kenmore, Chicago, Dept. S.

GIFT Edition stamp annual free. Sixty pages with hundreds of illustrations featuring Canadians, Newfoundlanders, United States, Colonials, foreign, supplies. Sent free. Gray Stamp Co., Dept. PR, Toronto, Canada.

STAMP Collectors read Popular Science Classified Advertising regularly. Your ad here will reach almost three million readers. Write for details today. O. K. Kelly, 353 Fourth Ave., New York, N. Y.

NEJD (Arabland), Bolivia triangle, Caymans, Negri Sembilan, Turks Caicos, Manchukuo, Bahamas, British Solomons (Cannibaland). Everything 3c with approvals. Viking, 130-P Clinton St., Brooklyn, N. Y.

SCARCE Diamond airmail! Wonderful packet 115 different from strange countries. British Colonies, Haiti, Tasmania, pictorials, etc. 5c to approval applicants. Reliable Co., Dept. 8, Box 139, Church Annex, New York.

BIG Triple offer—50 different Czechoslovakia, 25 different French Colony pictorials, complete Russian set plus free stamp wallet, 10c approvals. Official Stamp Co., Box 301-S, Fairlawn, N. J.

SIX dollars for 9c! 300 different stamps (Cat. price \$6.00) only 9c with approvals. Tatham Stamp Co., Springfield-50, Mass.

50 DIFFERENT, fine U.S. including perforation Gauge, 10c with approvals. The Stamp Shop, 813 Holland Bldg., St. Louis, Mo.

FREE! Pony Express set (facsimiles). Postage 3c. Roberts, 401 Shearerbig., Baycity, Mich.

100 DIFFERENT Portugal 25c, approval applicants. Hermes Stampco, Box 276, Hempstead, N.Y.

5 DIFFERENT Sets, French Colonies, etc., 10c. No junk, Lufberry, Middletown, Conn.

50 BEAUTIFUL Colonials—3c approvals. Kravat Company, 1925-P Quentin Rd., Brooklyn, N. Y.

NINETEEN Century U. S.—10 different 10c. 20 different 30c. Elzea, Bowling Green, Ohio.

EXCHANGE your duplicate stamps. List, Swappers, dime, Registrar, Box 2166, Denver, Colo.

UNITED States stamps on approval—Big discounts. Stamp Company, Broadway, Albany, New York.

UNITED States \$4 and \$5 stamps Free to approval applicants sending 5c for 100 all different. Wineholt, Woodbine, Penna.

LATIN America—35 different 5c, approvals. Ransom, 1333 Pontiac, Ann Arbor, Michigan.

FIVE scarce Coronations 10c approvals. Thode, 14302-119 Ave., Jamaica, New York.

FREE! Austria war set. Postage 3c. Williams, 601 Archerbldg., Baycity, Mich.

THREE sets for 3c stamp! Jack Reed, Jr., Houtzdale, Penna.

NUDE Duchess Set (two), 5c. Approvals. Laurence Shultes, Berne, N. Y.

PENNY Approvals that satisfy. Neil Gronberg, Box 5441S., Philadelphia, Penn.

72 DIFFERENT U. S. 10c. Album Service, Route 57-10, Sioux City, Iowa.

WHOLESALE Stamps; 50c per pound. Mission, 857 South 89th, Wauwatosa, Wis.

PENNY Approvals by country. M. H. Hoerning, Merriam, Kansas.

SURVEYING INSTRUMENTS

GUARANTEED Factory rebuilt transits and levels for rent (with purchase option) or sale (cash or terms). We will repair, trade in, or buy your old instruments. Ship prepaid for cash valuation. Write for list PS57 and complete information to Warren-Knight Co., 136 North 12th St., Philadelphia, Pa.

TATTOOING SUPPLIES

TATTOOING. Engraving. Outfits. Illustrated list free. Percy Waters, Anniston, Ala.

TYPEWRITERS, OFFICE DEVICES

TYPEWRITERS, adder, mimeograph, multigraph, addressograph. Send for free lists of machines that will help you at half price. Pruitt, 23 Pruitt Bldg., Chicago.

WANTED—MISCELLANEOUS

CASH for used Microscopes, binoculars, slide rules, drawing sets, scientific instruments, tools, cameras. Satisfaction guaranteed or shipment returned. Elman's, 108-S South Clark, Chicago.

WANTED—False teeth, Crowns, bridges, gold, platinum, jewelry. Goods returned if price is unsatisfactory. Western Metal Co., Bloomington, Ill.

QUICKSILVER (Mercury), 90c pound remitted, promptly. Wholesale Terminal, Norwood, Mass.

WATCHES

WATCH-REPAIRING is steady profitable work. Experts usually in demand. You can learn watchmaking trade at home, spare time. New original instruction system. Script engraving course included. Write for free details today! Nelson Company, 500 Sherman, Dept. J-2005, Chicago.

WATCHMAKERS' Materials—tools; watches; jewelry. Bought, sold, exchanged. Best prices for old gold, diamonds. Ben Segal Company, Mellers Bldg., Chicago.

WATCHMAKERS' Tools, supplies. Watch parts. Lowest prices. Write for price list 46. Dean Company, 87 Nassau St., New York.

WELDING, SOLDERING

ARC-WELDER plans \$1.00 each. Build your own from Dodge generators, vehicle motors. Light plant generators. Welders Club, WB-3432 M-Mart, Chicago. (Forty-nine arc-welding lessons 50c; Foreign 75c).

BARGAINS. Demonstrator Arc Welders, gasoline and electric drive. Liberal trial, easy terms. Write Hobart Welder Exchange, Box P9402, Troy, Ohio.

WELDING Generator, 300 Ampere, 800 RPM Ball bearing mounted exciter complete with regulator, \$145.00. Wilnot Auto Supply, 2247 St. Paul Ave., Chicago.

ARC Welder—Easily built from old auto generator. Instructions, diagrams, plans, 25c. Craft Shop, 800-175 North Clark, Chicago.

WELDERS, new and used. Write Lincoln Electric Company, Cleveland, Ohio.

110-220 VOLT arc welders, helmets, plans, material. Holgerson, Canton, Kansas.

Big Load of Flavor

and never
a kick!

P. O. HARBAGE
won Amateur and Open
Clay Target Championships
with scores of
200 straight!

VELVET... just tamp
'er down and bang away...
stays cool under steady
firing. It's Kentucky's finest
Burley tobacco . . . aged
longer . . . mellowed with
real maple sugar. The mild-
est makin's for a pipe or
cigarette.

Velvet

*the Right Word for
Smooth Smoking*

MILD and COOL
Positively NO "BITE"

Copyright 1940,
LIGGETT & MYERS
TOBACCO CO.

Our Built-In Index...

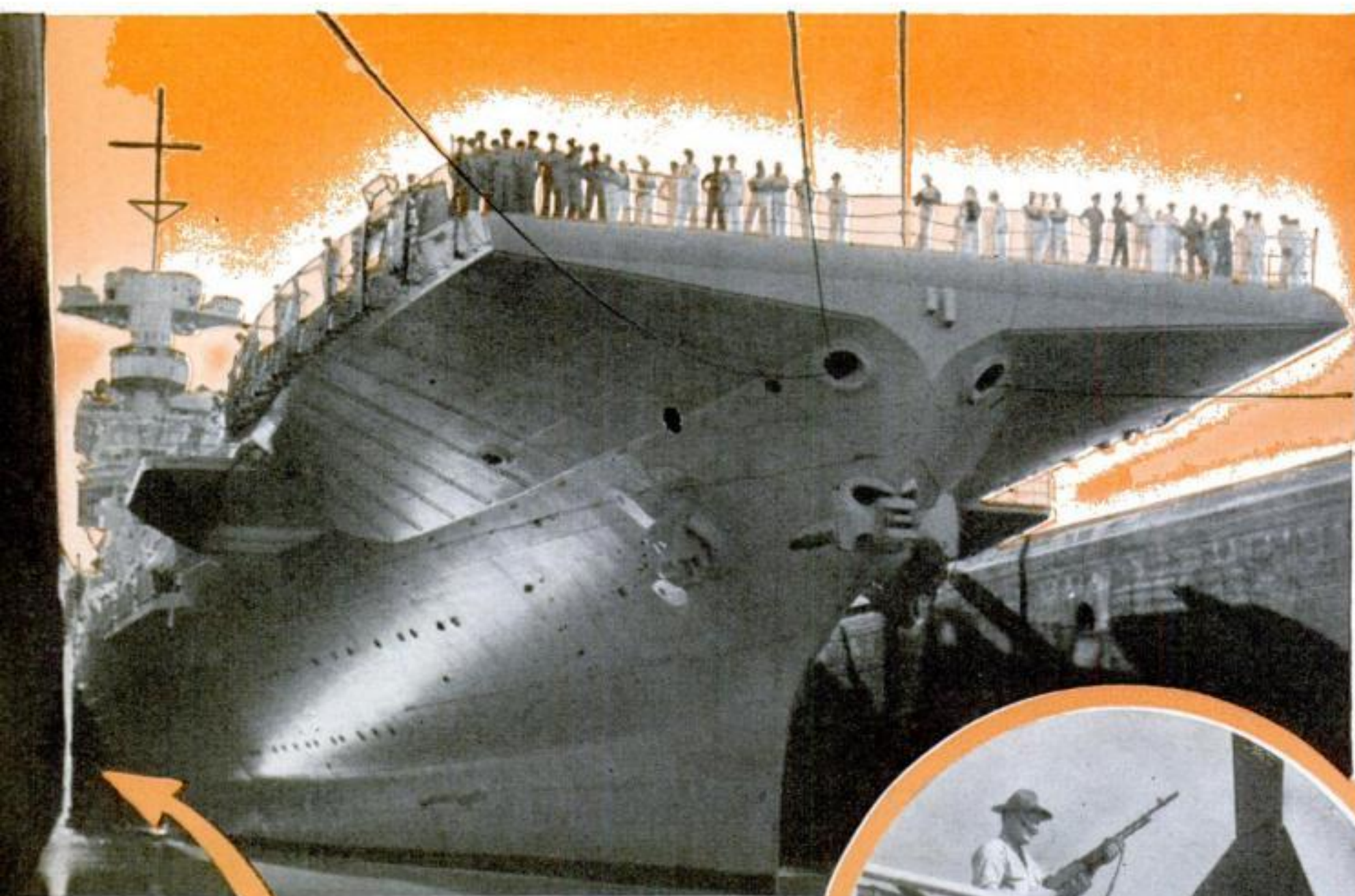
POPULAR SCIENCE MONTHLY, always easy to read, now comes to you in an easier-to-use form. The hundreds of up-to-the-minute articles we publish each month now are grouped according to their subject matter and special titles at the bottom of every page provide a ready-reference index to the material that interests you most. It was for your convenience that this change was made. If you like it, please let us know.

RAYMOND J. BROWN, Editor

ANIMALS	72
AUTOMOBILES	124
AVIATION	46
CAMERA HINTS	182
CRAFTWORK	172
CRIME	67
ELECTRICITY	178
ENGINEERING	42
HOBBIES	88
HOME & FARM	119
HOME SCIENCE	190
INVENTIONS	78

LABORATORY NEWS	103
MILITARY	93
MODELS	186
NEW SHOP IDEAS	148
ODDITIES	115
OUTDOORS	165
PHOTOGRAPHY	111
RADIO	194
SPORTS	52
THE HANDY MAN	156
WOODWORKING	136
YOU	85

Enlarging the Panama



There isn't much room to spare when the aircraft carrier "Lexington" passes through the present locks. At right, guarding a vital point

By **ALDEN P. ARMAGNAC**

STEAM SHOVELS will soon be clanking again at the Panama Canal. Only a little more than a quarter century after the opening of this "life line" of the U. S. Navy and crossroads of the world's maritime commerce, workers will break ground for a monster third set of locks—a project whose \$277,000,000 cost equals more than half that of the present canal!

The giant engineering scheme calls for conversion of the present "two-lane" canal across the Isthmus into a "three-lane" canal. To do this, three sets of oversize single-chamber locks will be built, parallel to the present twin-chamber locks but at some distance from them. There will be no need to dig a whole new canal, since the "Big Ditch" itself will easily carry the traffic.

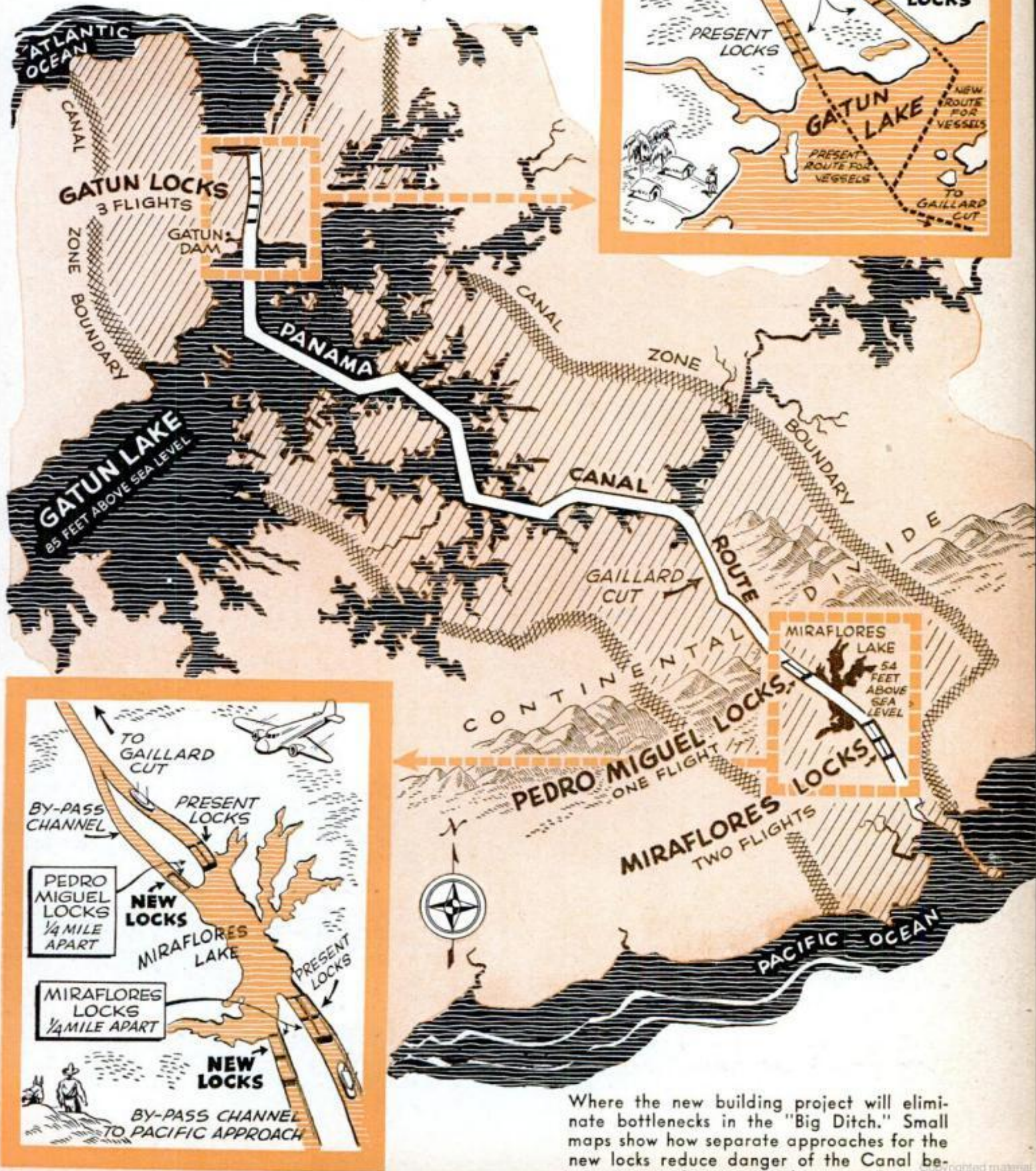
Why the new locks? First and foremost,

they will assure the U. S. Fleet of unobstructed passage between the oceans, in cases of emergency. Canal authorities long have been jittery over the possibility of sabotage or direct attack on the present locks. A vessel might be blown up, or time bombs might be dropped, in a lock chamber; or the locks might be bombed by raiding planes. If a heavy explosion or a lucky hit from the air happened to destroy two side-by-side lock chambers at once, the entire Canal would be put out of commission. Therefore, for many months, a force of sev-



Canal FOR BIGGER BATTLESHIPS

HOW A VAST ENGINEERING JOB
WILL BRING THE "BIG DITCH"
UP TO DATE IN PEACE OR WAR



Where the new building project will eliminate bottlenecks in the "Big Ditch." Small maps show how separate approaches for the new locks reduce danger of the Canal being put out of commission by enemy bombers

eral thousand men has been working night and day to equip the old locks with "special protective devices" of a secret nature. But the Navy will feel still more comfortable when the new locks are built, from a quarter mile to a half mile away from the old ones, so that both cannot be attacked simultaneously. Every known safeguard against bombing and sabotage will be built into them, from the foundation up.

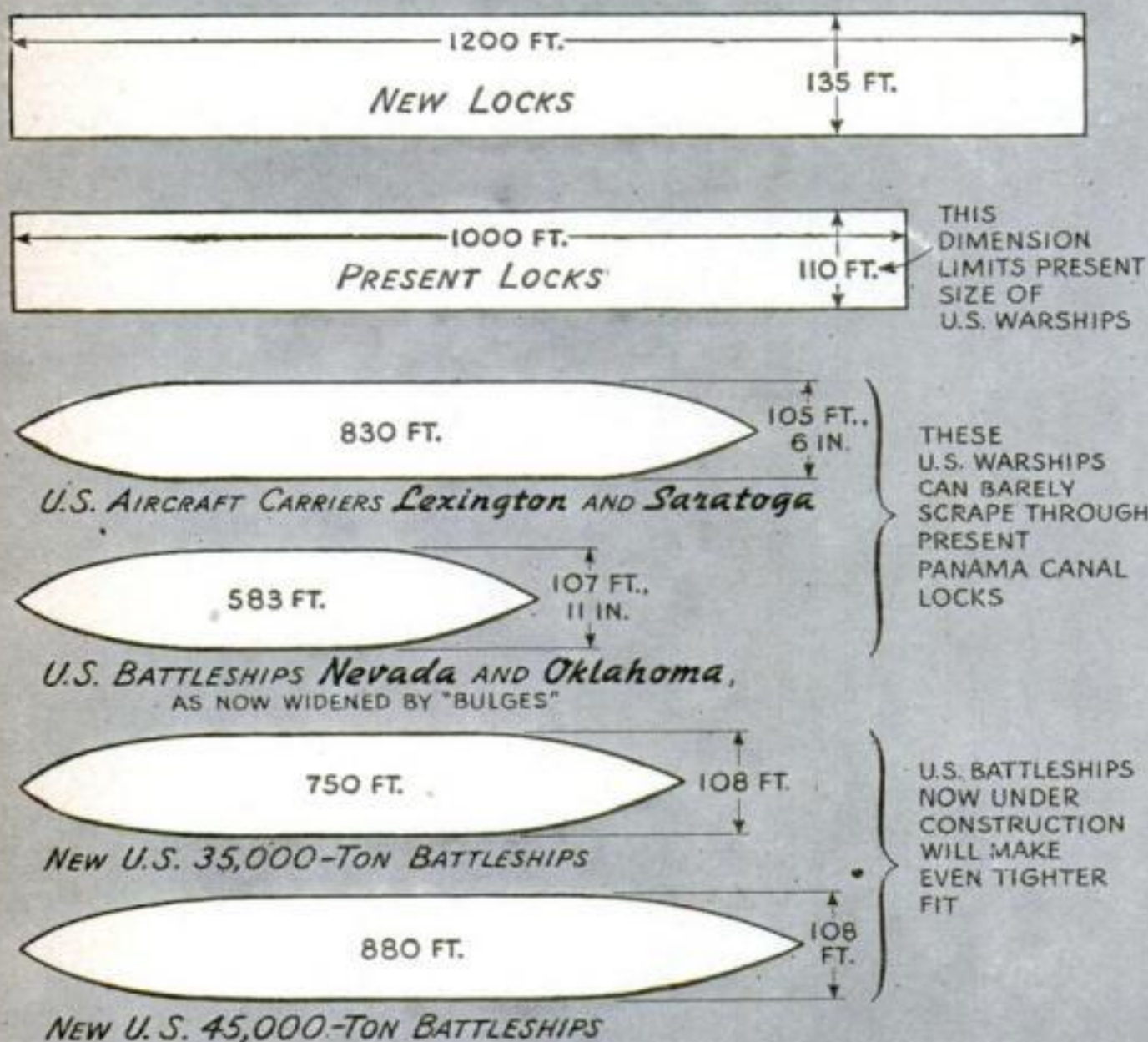
Secondly, the enormous size of the new locks, 1,200 feet long and 135 feet wide, will comfortably accommodate the biggest men-of-war and ocean liners afloat or contemplated. Widened by recent addition of antitorpedo bulges, some of our modernized

battleships can barely scrape through the old locks, with only a foot to spare on each side! Our giant aircraft carriers *Lexington* and *Saratoga* make almost as tight a fit. Until now, the 110-foot width of the existing locks has limited the dimensions of all U. S. warships, including the 35,000-ton and 45,000-ton battleships now under construction. As for the big merchant vessels, the *Queen Elizabeth*, the *Queen Mary*, and the *Normandie*, they could not squeeze into the old locks at all. The projected locks will have plenty of room for all comers.

Thirdly, the sheer volume of peacetime traffic through the Panama Canal, steadily rising through the years, will eventually call

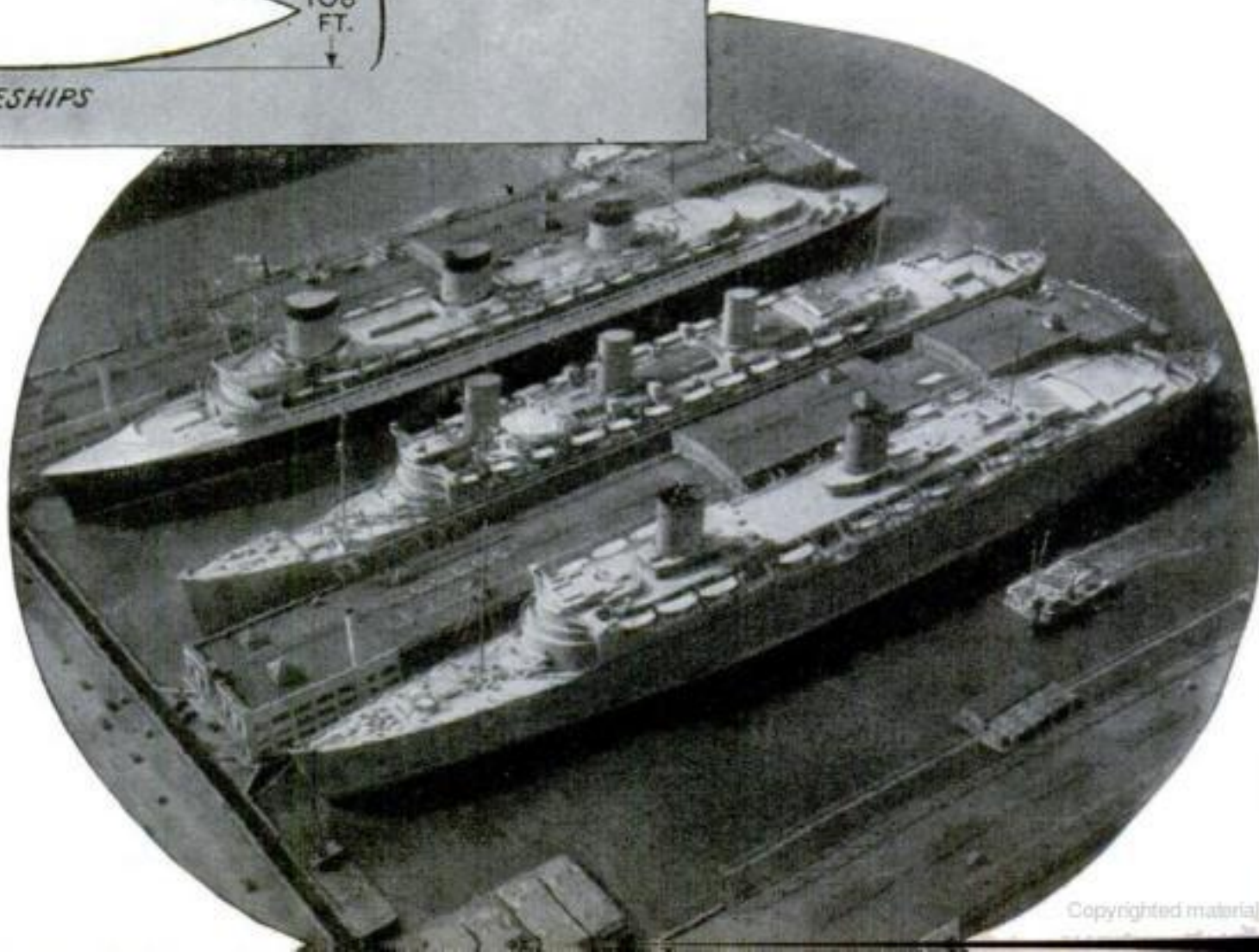
for more locks to handle it. From this standpoint alone, the Governor of the Panama Canal recently declared, the third-lock project should be started within nine to eleven years. Present plans simply advance the date for completion of an outstanding national asset, both in war and in peace.

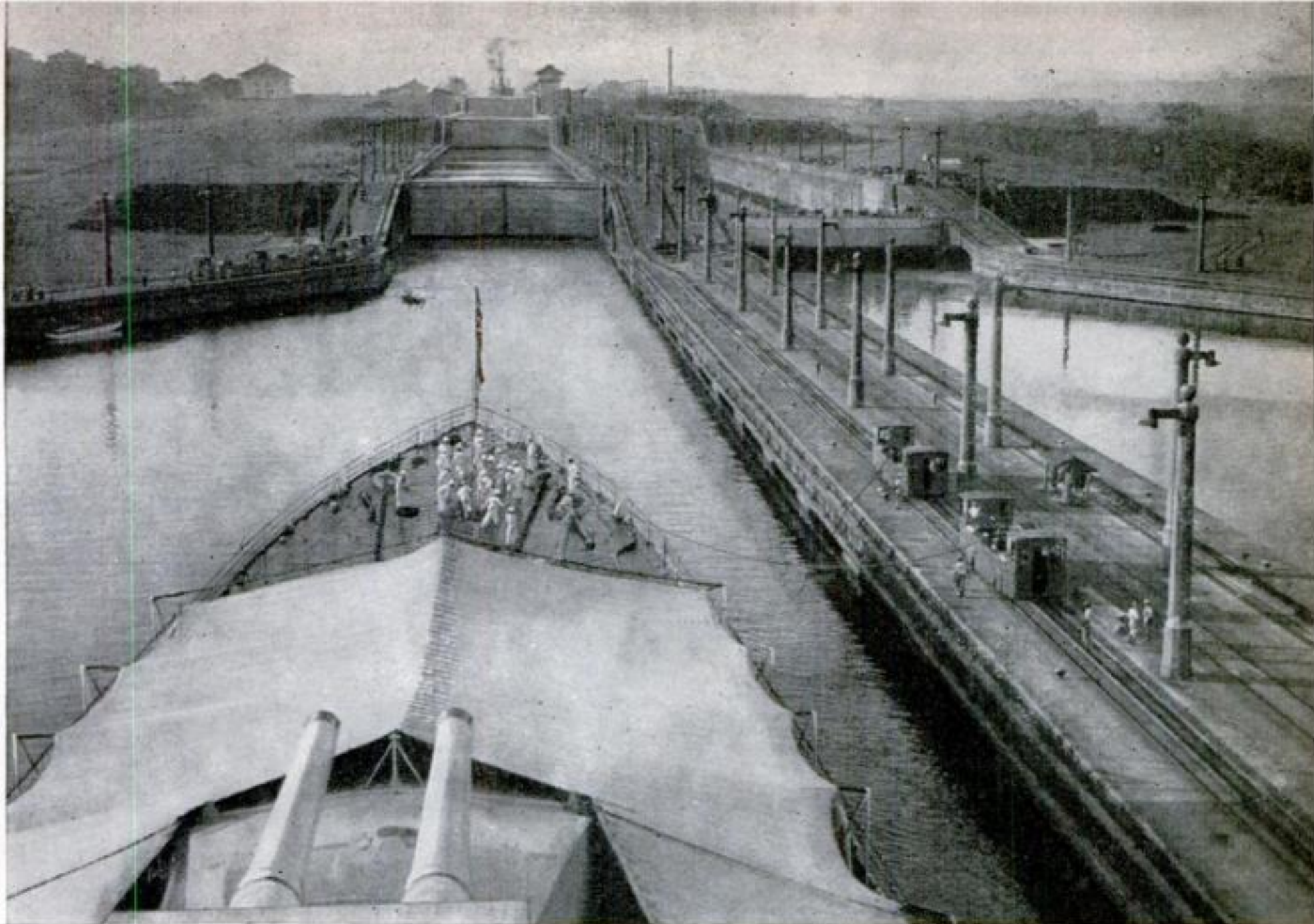
Connecting with the present waterway several miles above and below the existing locks, "by-pass" or approach channels will lead to the new locks, so that canal traffic may be shunted through either set. Criss crossing routes



MAKING THE CANAL FIT MODERN SHIPS

The drawing above illustrates how the design of our warships has been restricted by the size of the present Panama locks, and how the larger locks will permit the building of bigger and more powerful naval vessels. Three liners, the "Normandie," "Queen Mary" and "Queen Elizabeth" are too big for present locks





The present two-lane Gatun Locks. The new locks, connected to the canal through "bypass" channels, will be a half mile away. Below, a freighter plows through Gaillard Cut



will enable a ship to be detoured around locks that may be out of commission.

Starting from the Pacific, for example, a vessel may pass through either the old or new Miraflores Locks, which raise it in two lifts to Miraflores Lake. The old and new single-flight Pedro Miguel Locks then offer

alternate gateways into Gaillard Cut, the artificial arm of Gatun Lake formerly known as Culebra Cut. Separate channels from broad Gatun Lake allow the ship to be routed through either the old or new three-flight Gatun Locks for its descent to the Atlantic.

Favorable sites for the new locks and their channels were found by a preliminary survey in the field. With core drills, engineers brought up samples of subsurface rock, to make sure of a substantial foundation for the massive concrete lock chambers. Artificial earthquakes, produced by setting off explosives, proved the rock formations free of faults. Investigations showed that the present water supply would amply suffice for both the old and new lock systems.

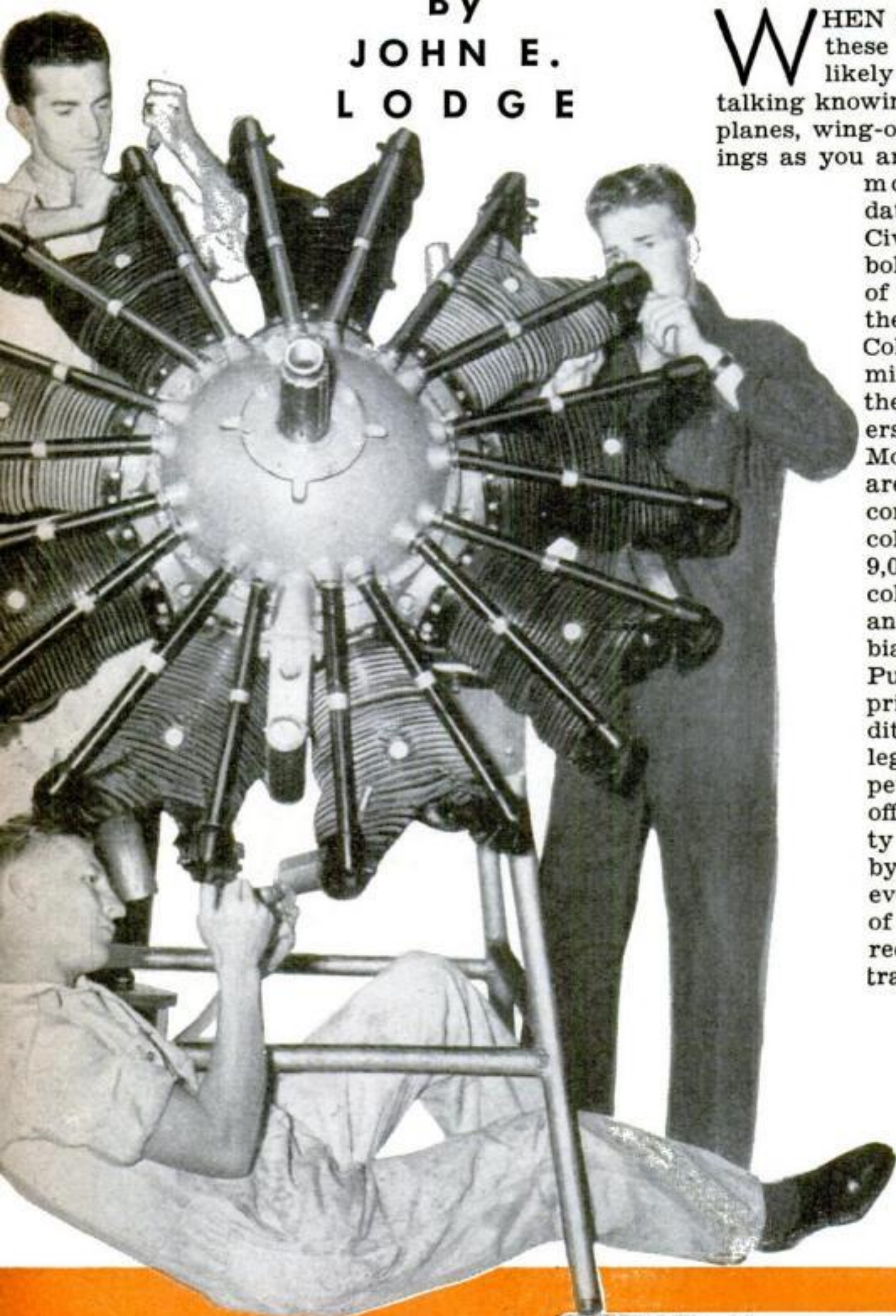
Actual work on the third-lock system will begin at once, with initial funds of \$114,000,000 just voted by Congress. As the huge project gets under way, whole new towns will spring up at construction centers. First steps include building roads, relocating railways, and excavating the locks sites and approach channels, which total about ten miles in length. Then will come the building of the giant locks themselves. Fast-moving world events may call for drastic speed-up measures to hasten the mighty engineering feat.

FLYERS BY THE TEN

By
**JOHN E.
LODGE**

WHEN you walk across a campus these days, you are quite as likely to hear undergraduates talking knowingly about low-wing monoplanes, wing-overs, and cross-wind landings as you are to hear them discussing mouse-trap plays, heavy dates, or passing marks. The Civil Aeronautics Authority's bold and successful venture of training youthful flyers by the thousands has made John College and Jane Coed go air-minded. Don't think that these collegiate aviation talkers are mere "hangar pilots." Most of them are flyers, or are well on the way to becoming flyers. During the college year of 1939-40 about 9,000 of them, enrolled in 437 colleges located in every state and in the District of Columbia, Alaska, Hawaii, and Puerto Rico, earned their private-pilot licenses. In addition, well over 700 noncollegians, winners of competitive flight scholarships offered the students in seventy ground courses sponsored by civic organizations in every state and in the District of Columbia and Alaska, are receiving exactly the same training.

College students learning about airplane engines as part of the ground-school training in the Civil Aeronautics Authority program



**Training Program in
Colleges To Provide
Huge Army of Pilots
for Uncle Sam**



THOUSAND

When this nation-wide training effort was started last fall, its primary objective was to accelerate the already swift progress of civil aviation in the United States by teaching large numbers of young men and women to handle their own airplanes safely in either pleasure or utility flying. A secondary objective was the building up of a reserve of physically sound, partially trained pilots for possible service in the Army or Navy in the event of war.

The swift and menacing march of world events in the past few months has brought about a reversal in the degree of importance placed on these objectives. Now most of the emphasis is on the national-defense aspect of the program, which has been greatly expanded. In the course of the coming year the C.A.A. courses will give ground and primary flying training of 45,000 students in three intensive courses, each of which, instead of being spread over the school year, will be compressed into four months. In addition, the 9,000 1940 graduates—over ninety percent of them have indicated their desire to become military flyers—will be given forty-five-hour advanced courses in faster planes than those which are used for the primary training.

The Civil Aeronautics Authority, the Government agency charged with the regulation of civilian aviation, has no direct connection with the armed services. The graduates of its flying courses are not combat flyers, and have no military obligations which are not shared by nonflyers of the same age. But the training they receive is the equivalent of the flying training given Army and Navy flying candidates, and it will enable many of them to qualify as com-

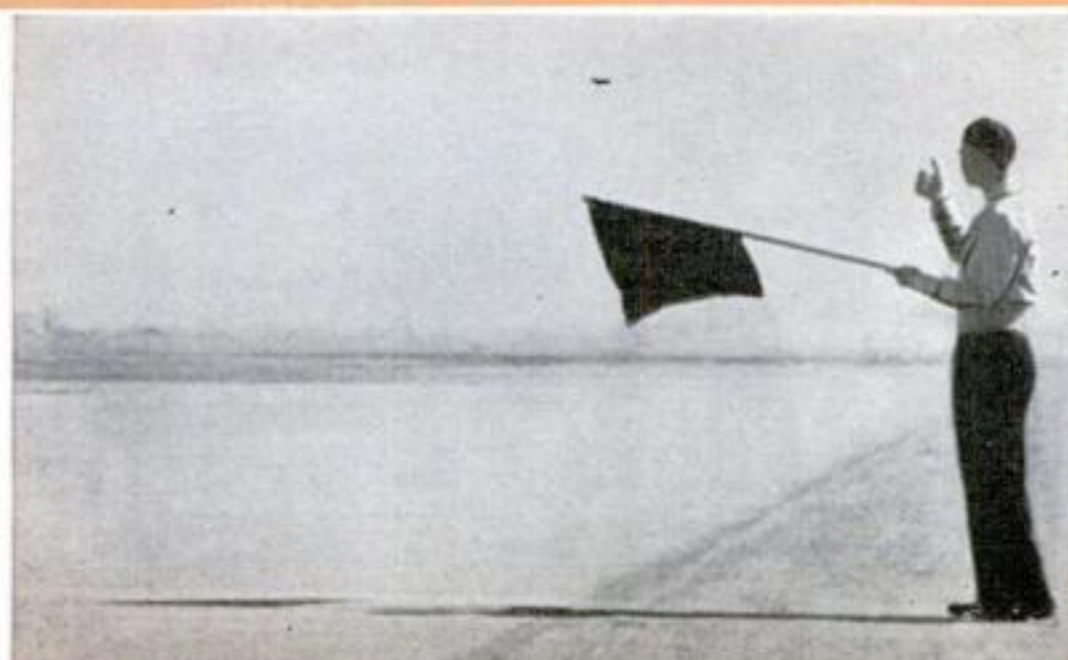


Girls are eligible, too, and many of them already have qualified for their private pilots' licenses

bat flyers after six months of advanced specialized training in service flying schools.

When the project of providing wholesale flight instruction first was considered late in 1938, an abnormally high percentage of student-flyer accidents was helping to make private flying, with a safety rate of only 750,000 miles for each fatality, the most hazardous form of aviation. But careful investigation indicated a method by which mass production of pilots might be achieved with a high degree of safety. It was found that the students of flying schools which had thorough ground courses and sound flight courses suffered far fewer fatalities than did the graduates of schools whose instruction standards were lower.

Placing heavy emphasis on safety, C.A.A. experts worked out a ground course which would teach students why and how airplanes fly, and a flight course which would enable instructors to nip bad flying habits in the bud. In the spring of 1939, with \$100,000 of National Youth Administration funds, a test program was started in thirteen selected colleges. Undergraduates enthusiastically grabbed at the chance to learn to fly—so enthusi-



A campus flyer comes in for a landing. The flight training is given by plane operators at near-by airports



In a flying classroom, students from the University of Miami, Fla., listen in with earphones to the radio-beacon signals and watch the instrument panel while soaring 7,000 feet above the earth

astically that at the University of Alabama there were 1,200 applicants for the thirty places in the class. A total of 330 students with high physical qualifications were accepted at the thirteen participating colleges. All of them reached the solo stage and 317 won private-pilot licenses. Their average flying time to the certificated stage was thirty-eight hours, and they flew a total of 1,200,000 miles with only a single fatality.

Convinced by this experience that the way to increase the safety of flight instruction was to raise the quality of the instruction, the C.A.A. standardized its ground and flying courses and required all airmen holding flight-instructor ratings to familiarize themselves

with the improved instruction methods and to pass an examination to prove that they had done so. More than 4,000 instructors passed the test, assuring the Authority of plenty of highly-qualified teachers for its training program.

Congress passed a Civilian Pilot Training Act and provided \$4,000,000 for the 1939-40 courses. Undergraduate interest was so keen that colleges ranging from stately ivy-



An instructor explains the working of the tail surface of a plane. The thorough ground training has produced a remarkable record for safety

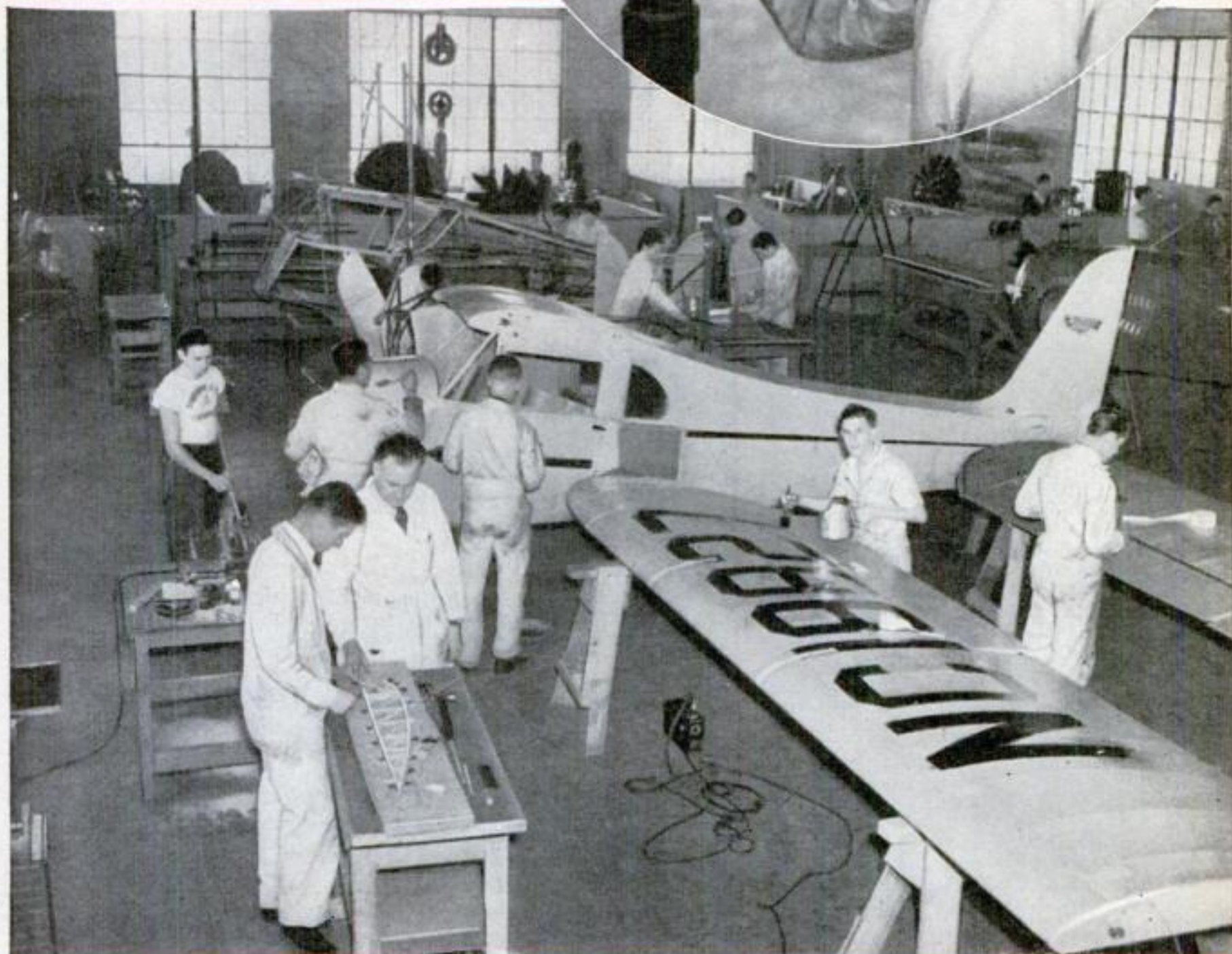
covered institutions to little city and junior colleges offered the pilot-training courses.

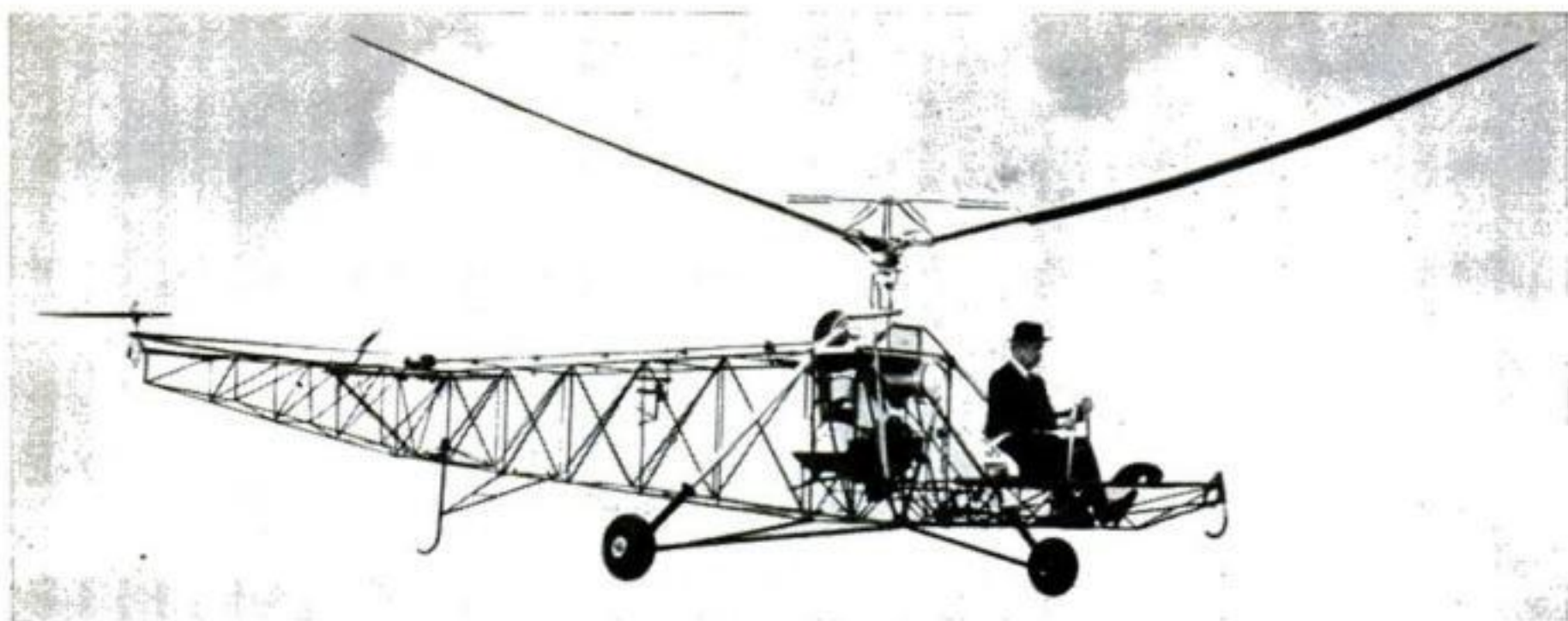
When school opened last September, over 9,300 undergraduates who had passed the searching physical examinations given by C.A.A. flight surgeons were accepted as students. By June they had logged 310,000 dual and solo flying hours—almost 22,000,000 miles—with very few mishaps and only one fatality. That remarkable record is an improvement of 3,700 percent over the safety record for flight training for the whole country only a year ago!

Under the terms of the Civilian Pilot Training Act at least five percent of those enrolled for the courses must be noncollege students. To provide instruction for these, the C.A.A. enlisted the coöperation of chambers of commerce, university-extension

services, American Legion posts, aeronautical associations, and civic clubs in communities of every state. The ground courses, which are exactly the same as those offered in the colleges, are open to anyone, but, to be eligible for one of the ten flight scholarships offered with each course, the student must pass the same physical examination given the col- *(Continued on page 219)*

Some schools have shops like the one below, where students learn to build and service aircraft by actual practice. At the right, a flying coed uses an instrument to gauge height of the "ceiling"

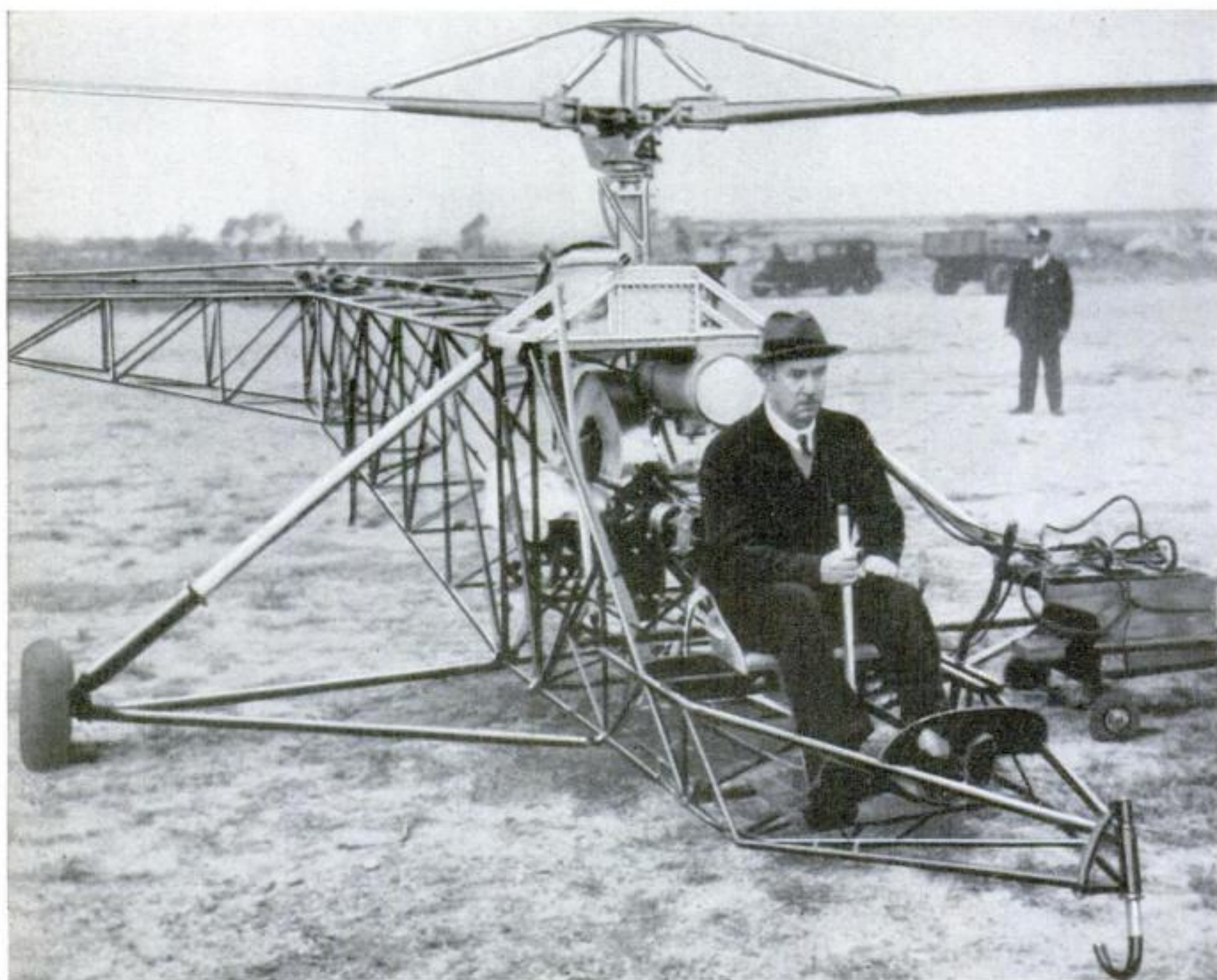




Helicopter Flown Successfully

WHAT is claimed to be the first successfully controlled vertical flight in a heavier-than-air machine was made recently by Ivor Sikorsky, prominent aeronautical engineer, at Bridgeport, Conn., in his new helicopter. Powered by a seventy-horsepower engine and equipped with variable-

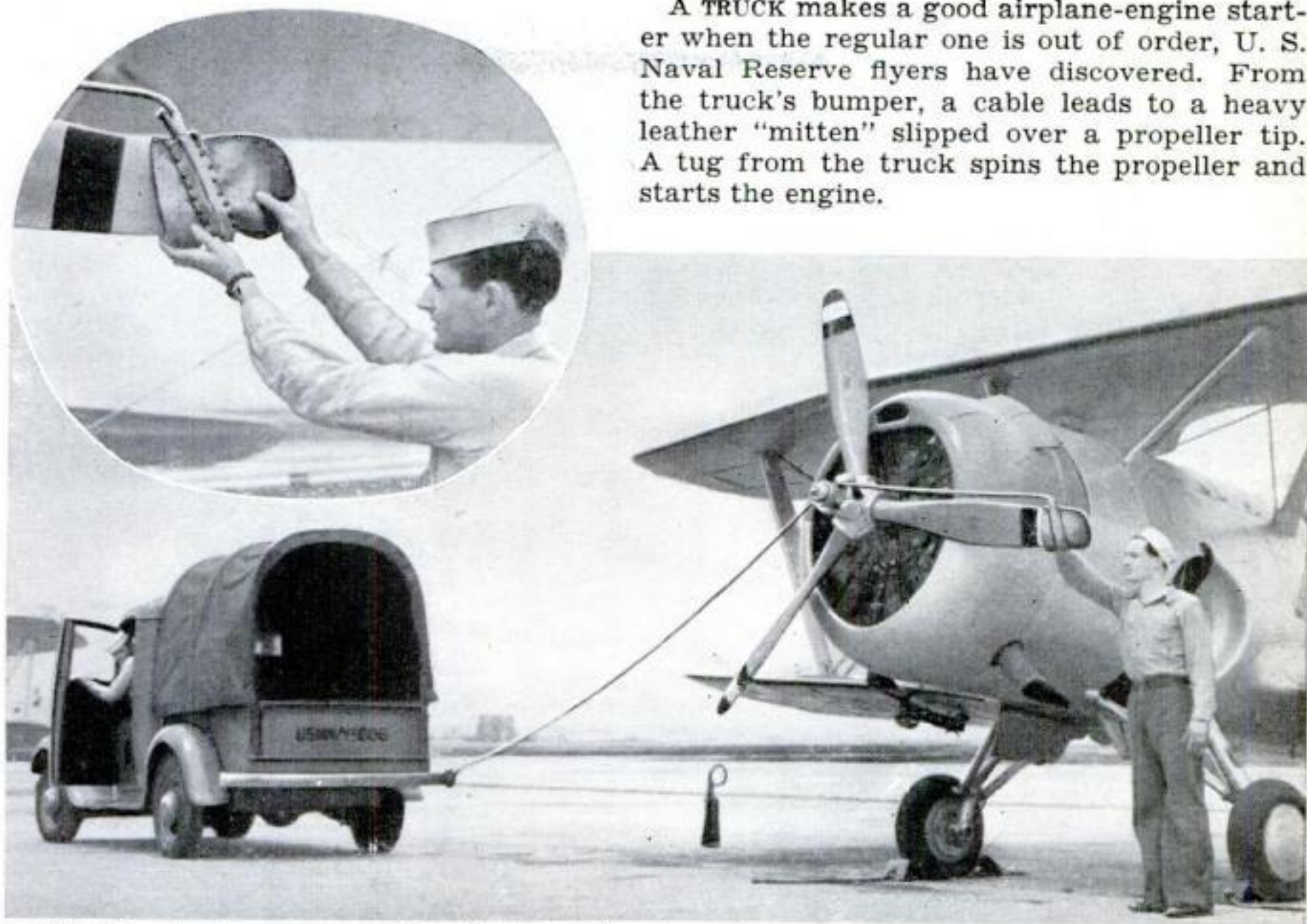
pitch rotor blades, the craft moved straight up from the ground for thirty feet, circled the field, and then settled vertically to the ground. Small rotor blades mounted on the bare fuselage of the craft act as elevators and rudder. Sikorsky is shown at the controls of the helicopter in the photographs.



Ivor Sikorsky about to take off on a test flight in his helicopter. At top, the odd machine in the air

Truck Serves as Plane-Engine Starter

A TRUCK makes a good airplane-engine starter when the regular one is out of order, U. S. Naval Reserve flyers have discovered. From the truck's bumper, a cable leads to a heavy leather "mitten" slipped over a propeller tip. A tug from the truck spins the propeller and starts the engine.



All set to spin the motor on a Naval Reserve plane. Inset shows "mitten" being placed on propeller tip

Baptism Marks Graduation of Naval Flyers

HE'S learned to fly for the Navy—and now three bucketfuls of water, symbolizing the Navy's domain, initiate this proud fledgling into the ranks of his fellow airmen at Floyd Bennett Field, New York City. Scarcely less than an official decoration, he will treasure the picture of the traditional ducking that a friend is about to snap. Sometimes, instead of getting a shower, a new pilot may receive the rare honor of being tossed off the pier. The Navy birdmen say there is little to choose between the soakings.



Navy pilots often land on the water. This time it's the other way around

BOW-AND-ARROW HUNTERS RIDE DESERT JALLOPIES

BOUNCING over boulders, zooming up steep embankments, plunging down gullies, two mechanical mountain goats, created from automobile odds and ends, carry Walt and Ken Wilhelm, of Yermo, Calif., on daring expeditions into the Mohave Desert. Aboard these remarkable vehicles, called Lena and Prowler, the two brothers chase jack rabbits, rope coyotes, hunt game with bows and arrows, explore remote corners of the desert, search for fossils, trail outlaws, and rescue lost travelers.

They think nothing of starting Lena or Prowler across the desert, leaping out and riding lickety-split over cactus and across the frequent washes on sleighs or toboggans attached behind. By slipping a U bolt over

a spoke of the steering wheel, either car can be directed in a straight line or a wide circle. Sand banks and boulders offer no obstacles to the huge tires. Near Yermo, I once watched Prowler roaring driverless around a circle nearly two miles wide. The car plunged down narrow gullies, slithered through sand, overrode needle-pointed cactus spines, returning in ten minutes to our side.

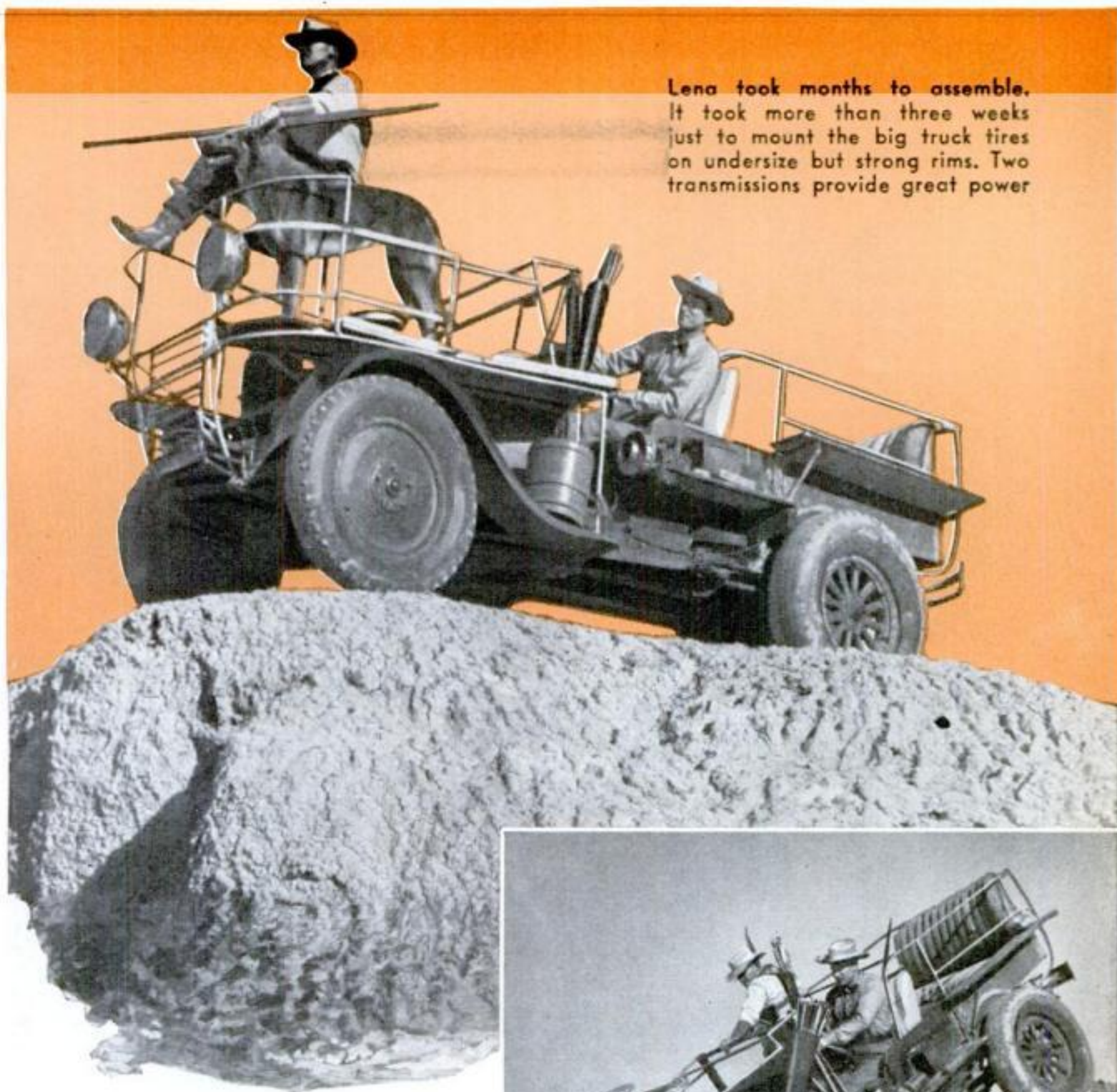
When the car approached, both men fitted blunt arrows to their bows, and as it passed Walt fired quickly at a large rice-straw target slung behind the back seat. As the broad-head struck the bullseye, the automobile motor stopped dead and the car coasted to a halt. "We never go out unless the disconnect switch is in working order," Walt

explained. "Once we were thrown out while riding over rocks and the car crashed into a narrow canyon." The thump of an arrow provides force enough to slap the target against the pro-

By
**ANDREW
R. BOONE**



Standing on Lena's front platform, Walt Wilhelm "shoots from the hip" at a coyote. Left, with the kill



Lena took months to assemble. It took more than three weeks just to mount the big truck tires on undersize but strong rims. Two transmissions provide great power

jecting switch installed underneath it.

Only once has this bow-and-arrow shut-off failed them. During an early hunt for fossils at the edge of Death Valley, they mounted the toboggans and took off for a slow survey of greasewood on a flat mesa. Noting the car approaching near-by badlands, Ken prepared to loose an arrow, but his bow broke.

"What happened to the car?" I inquired.

"She's still there—a mess of junk."

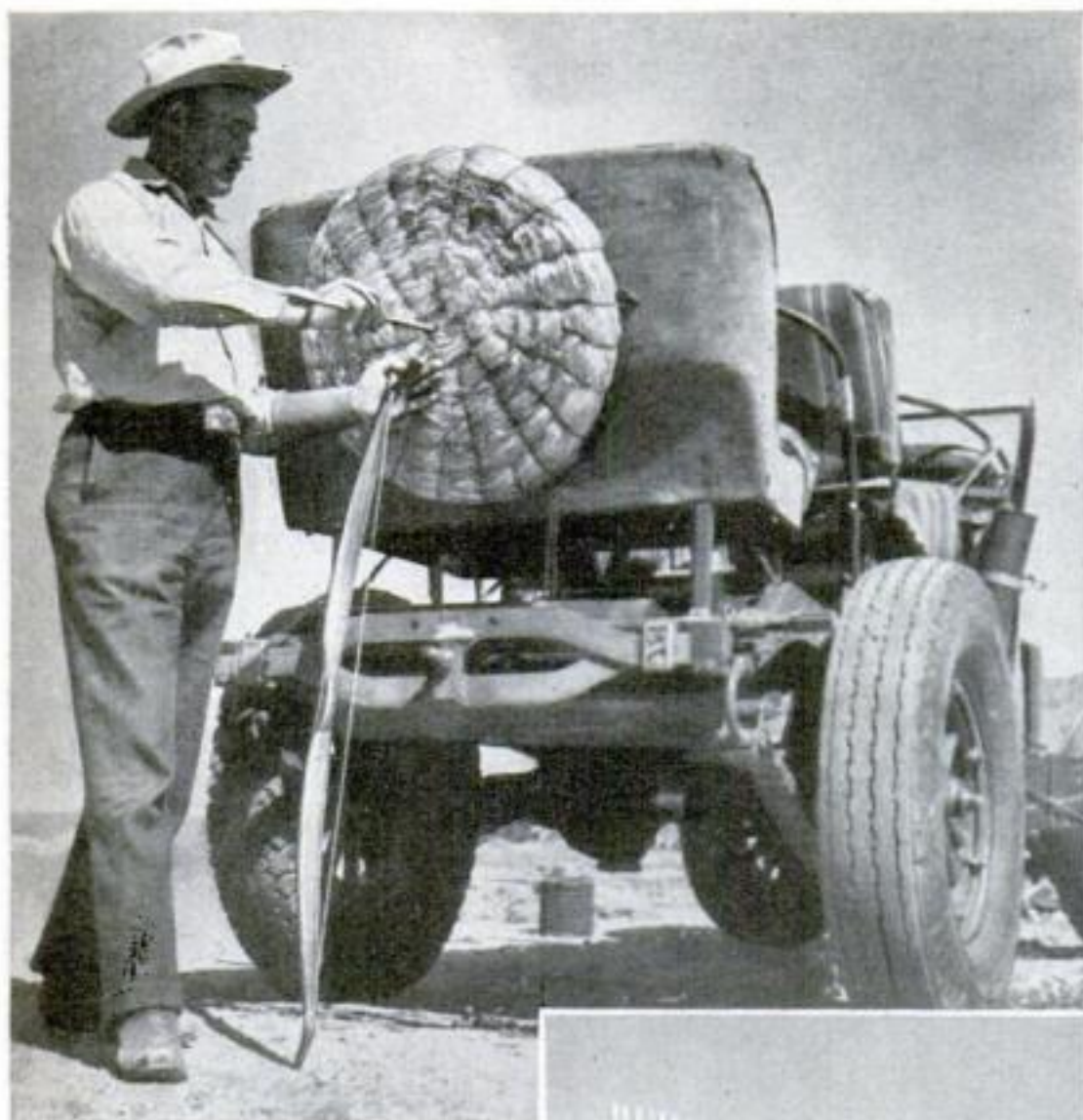
That was loss number one. A few months later, while playing around the treacherous potholes of Soda Sink, Walt felt the tires sinking. Leaping to the soft earth, Ken and he rolled half a city block to hard ground. When they returned thirty minutes later with timbers, the car had disappeared in quicksand.

Both Ken and Walt will tell you they assembled their unique desert cars for the thrill



Walt springs to a safer seat, and the sturdy contraption plows straight off the edge of the hill

of bumping along off the beaten path. That is the truth but not the whole truth. Both brothers are enthusiastic archers. In the desert, they are able to practice incessantly, now shooting at a bounding jack rabbit, again loosing arrows at an artificial deer



AUTOMATIC CUT-OFF, DESERT STYLE

In case the boys are thrown by a bump, an arrow shot against the target stops the vehicle. With the wheel clamped (below), it travels in any fixed circle. The siren is a coyote "decoy"



which Walt built not long ago. Driven by a gasoline motor and eccentric gear, it jumps up and down in the brush exactly like its prototype. So expert has their desert practice made them that last summer Ken set a new world's record for distance shooting. He is the first man in all history officially to send an arrow farther than half a mile.

For nearly twenty years, the Wilhelms have been exploring the Mohave in various kinds of vehicles. Gradually, they evolved their present cars. You could buy the parts for either Lena or Prowler at a junk yard for \$200 or so. But you'd work six months putting them together. It took the brothers exactly twenty-four days merely to fasten the tires to the rims. They started with huge, twelve-ply truck tires. Boots, countersunk and held firmly over blow-out holes by carriage bolts, went in ahead of the tubes. Using hydraulic jacks, they struggled until they pushed the thick beads onto the narrow rims of twenty-inch wheels. So tightly are the beads wedged that flats never bother them. "The tire walls are very strong," Walt explained. "They'll carry us anywhere; and by forcing



the tires on narrow rims, we anchored them so they can't turn and tear the valves out."

In each of the machines, they installed two gear boxes, giving them many speeds forward and in reverse, too. Carrying only eight pounds of air in the tires, they can push up a steep, rocky hill with the engine turning fifty revolutions to one of the rear wheels, or they can speed along the smooth high-

way at a two-to-one ratio. The big tires take up most of the shock in rough going. "You oughta see Ken when he's in a hurry," Walt told me. "He'll jump straight off an embankment, going fast enough to land on his wheels."

Sometimes, but not always. Once, Ken tried this stunt while chasing a coyote, and straddled a hillock, breaking the motor block in half. After walking eleven miles for help, he decided to armor-plate the motor. Now, both Lena and Prowler are protected by a heavy sheet of boiler-plate, bolted against a cushion of wood beneath the pan of each engine.

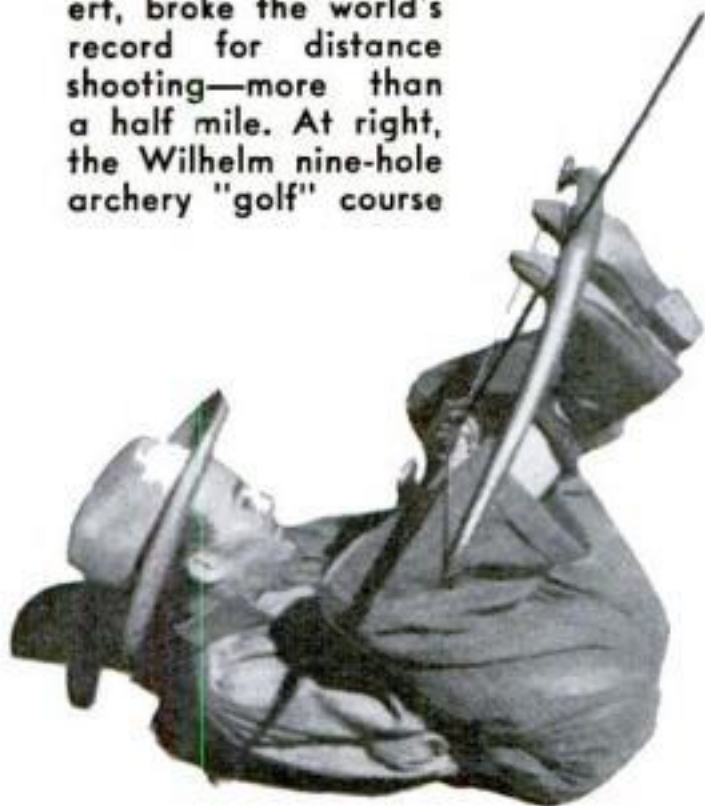
Another time, the Wilhelms were grinding cross-country in Nevada, fifty miles

from the nearest crossroads, when the welds holding a disk wheel to the flanges broke under the pounding vibration. Should they try to repair the damage, or walk three days for help? Walt took down their .30/06 rifle and shot three holes through the disk to form an approximate triangle. Next, he shot three holes in the flanges, outlining a similar triangle. Finally, they bolted the wheel back into place and drove slowly to a distant mine. Here, using salt and fine sand as a flux, they brazed the metals tightly with the metal from used rifle shells.

On several occasions, the adventurous pair and their desert cars have been pressed into service by the local sheriff for hunting outlaws, and on other occasions they have headed into the Mo-have on errands of mercy. The most spectacular of these trips was a sixty-mile journey through snow and over two mountains, carrying food to a dozen starving miners. As an aid to keeping in touch with each other when roaming through desert wastes, the brothers recently added the latest pieces of equipment carried by Lena and Prowler: a pair of midget short-wave radio sets. If either brother is in difficulties, he can send out an SOS with the assurance that the other machine will soon put in an appearance, taking gullies and rocks in its stride.

When the going gets really tough and there is obviously danger of Lena or Prowler sliding down a hillside to disaster, the boys halt. But not for long.

Here is the way Ken Wilhelm, after long training on the desert, broke the world's record for distance shooting—more than a half mile. At right, the Wilhelm nine-hole archery "golf" course



This mechanical deer bounds across the plains realistically, providing excellent bow-and-arrow practice


Selecting two straws—one longer than the other, they draw lots. The one "winning" the draw takes over the wheel and drives.

Climbing a steep mountain one morning, they approached a sharp switchback. Out came the straws. Ken won. Before they got out of their fix, it was sunset. Yet they set out for more sport like it next day.

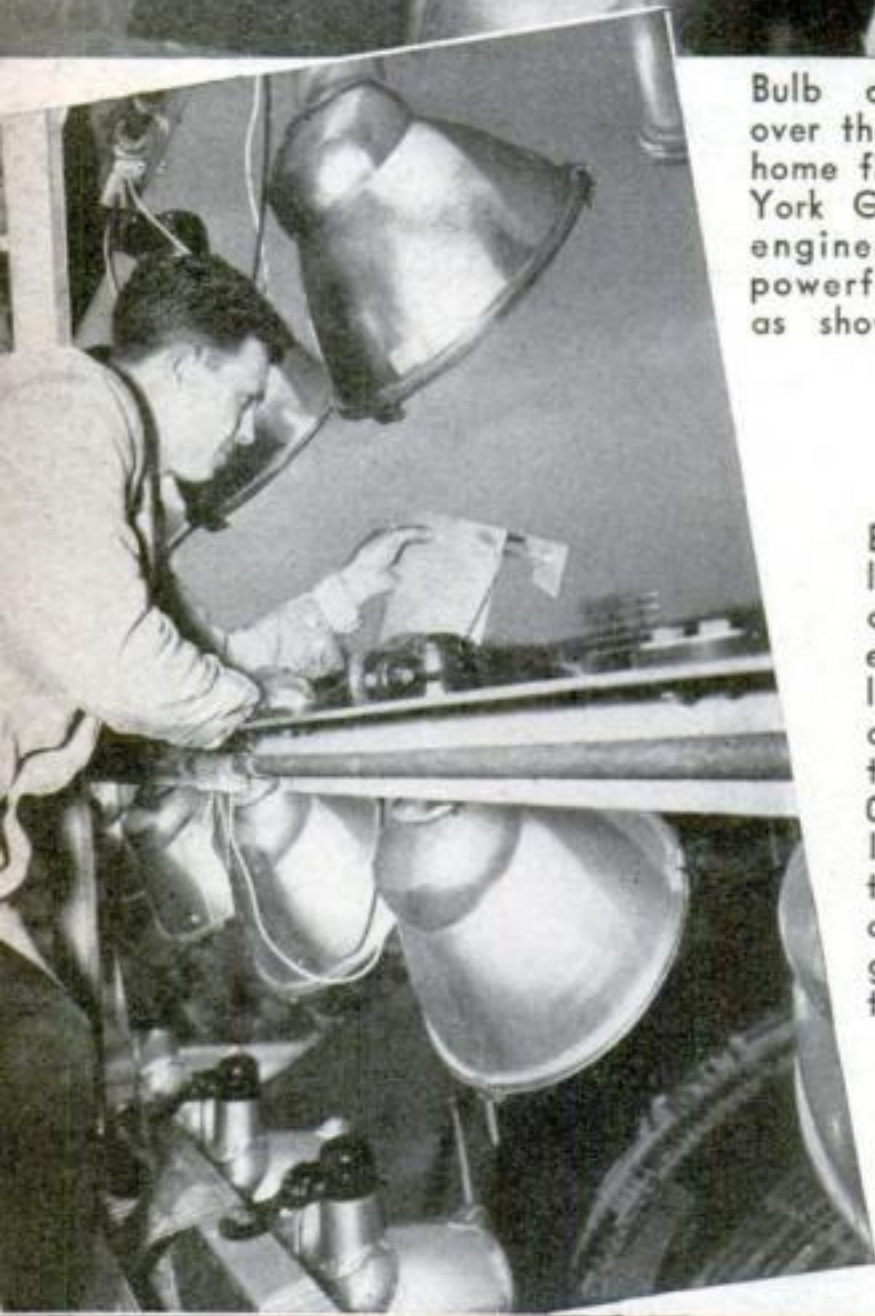


836 Giant Bulbs Light Diamond

A NEW 200,000,000-candlepower lighting system, most powerful on any sports arena in the world, turns night into day for baseball players and spectators at the Polo Grounds in New York City. Eight steel towers resembling monster telegraph poles rise 150 feet above the New York Giants' home field. Cross-arms carry a total of 836 floodlights, each of 1,500-watt capacity. To assure the right distribution of lights, the cartons of the bulbs were spaced on the field as targets. Then Westinghouse engineers, using rifle-type sights, trained each lamp on its mark. Strongest illumination falls upon the infield, because of its concentration of players and speed of action. The light supplied would illuminate 4,000 homes.



Bulb cartons spotted over the Polo Grounds, home field of the New York Giants, to guide engineers in aiming powerful floodlights as shown at the left



Eight tall towers like the one seen at the right hold enough 1,500-watt lights to produce a total illumination of 200,000,000 candlepower. In the view below, the vast arena is aglow for a night game. Note the distribution of light



Uncle Sam's Shooting Gallery





Three marksmen on the firing line. The annual National Rifle Matches at Camp Perry, Ohio, in August, draw crack shots from the country over

**AMERICA'S BEST SHOTS
RUB ELBOWS WITH DUBS
AT GUNPOWDER JUBILEE
RUN BY THE U. S. ARMY
FOR SPORT AND DEFENSE**

By
Edward W. Murtfeldt



In the pits, checkers haul down targets from their racks to count the hits. Bullet holes are patched with squares of adhesive paper, as shown at the right



TRAVELING in planes, trains, buses, private cars, trucks, and even on foot, more than 10,000 eager men, women, and youngsters from all corners of the nation will head toward the shores of Lake Erie in mid-August for the largest sporting event in the world. The lure that draws this myriad of bankers, housewives, G-men, clerks, police, shopkeepers, and citizens from practically every other walk of life, is the annual National Rifle Matches sponsored jointly by the U. S. War Department and the National Rifle Association.

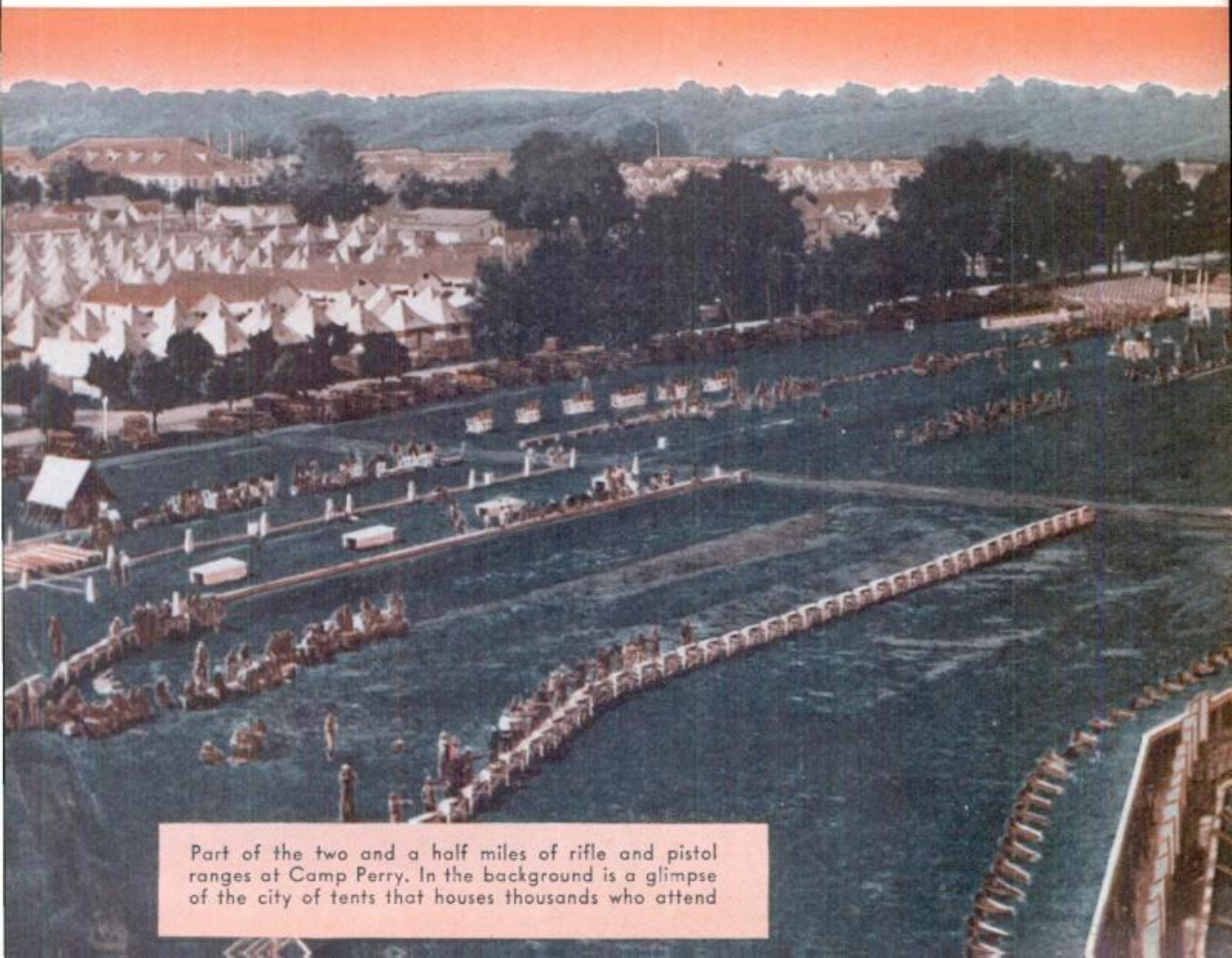
In this mammoth gunpowder rodeo, millions of rounds of ammunition will be fired from pistols, .30 caliber rifles, and small-bore guns. Police will school themselves in getting the jump on criminals. Hundreds of beginners will learn how to shoot and how to handle guns safely. Marksmanship records will be assaulted, historic trophies won, and national champions crowned. And at the end of the three-week bullet jubilee, a new group of straight-shooting citizens will scatter to their homes to add to the defensive power of the nation and to the worldwide reputation of the United States as a country of crack shots.

The shooting starts August 18 at the

Army's Camp Perry, a few miles from the lake town of Port Clinton, Ohio. Nowhere else in the world, experts state, is there a rifle and pistol range that can compare with it. Here, stretched out side by side for two and a half miles, are target ranges of every size from 1,000 yards for .30 caliber rifle competition to twenty-five yards for pistol events. And around the fringe of the ranges is a far-flung city of tents to house the extensive Army personnel required to run the matches, and also to accommodate practically all the contestants and visitors.

For the matches are open to any citizen of the United States, and the Army will put up any American who wants to compete. Tents, beds, and bedding are supplied without charge, while a mammoth cafeteria serves meals at low prices. For the rifle or pistol fan who would like to bring his family, the "Squaw Camp," a part of the reservation next to the bathing beach, is set aside. Here a man and his wife can have a floored, screened tent, with electricity, for \$1.50 a day. Bringing junior along adds just fifteen cents a day to the tent cost.

And you don't even have to own a gun, for the Army will issue you a .30 caliber rifle, or a .45 caliber pistol, and furnish all



Part of the two and a half miles of rifle and pistol ranges at Camp Perry. In the background is a glimpse of the city of tents that houses thousands who attend



the ammunition you'll need for match firing. If you've never fired a rifle, a competent Army instructor will show you how.

In addition to the vanguard of individual contestants, the Perry meet will attract civilian rifle and pistol teams from every state in the union, plus teams representing the National Guard, metropolitan police forces, the U. S. Army, Coast Guard, and Marine Corps, the Customs Service, the White House police, G-men, and other state and Federal agencies. Last year, almost 5,000 persons competed, firing a total of more than 3,000,000 shots.

Step out on the range when the matches get under way and you'll see a sight that you'll never forget. With the roar of service rifles in your ears, you will gape at a two-mile line of fire. Crack marksmen, lying prone, are battering bullseyes 1,000 yards away. Down the line, under the watchful eyes of soldiers and officers, civilians are getting their first chance at firing the new Garand semiautomatic rifle recently adopted by the Army.

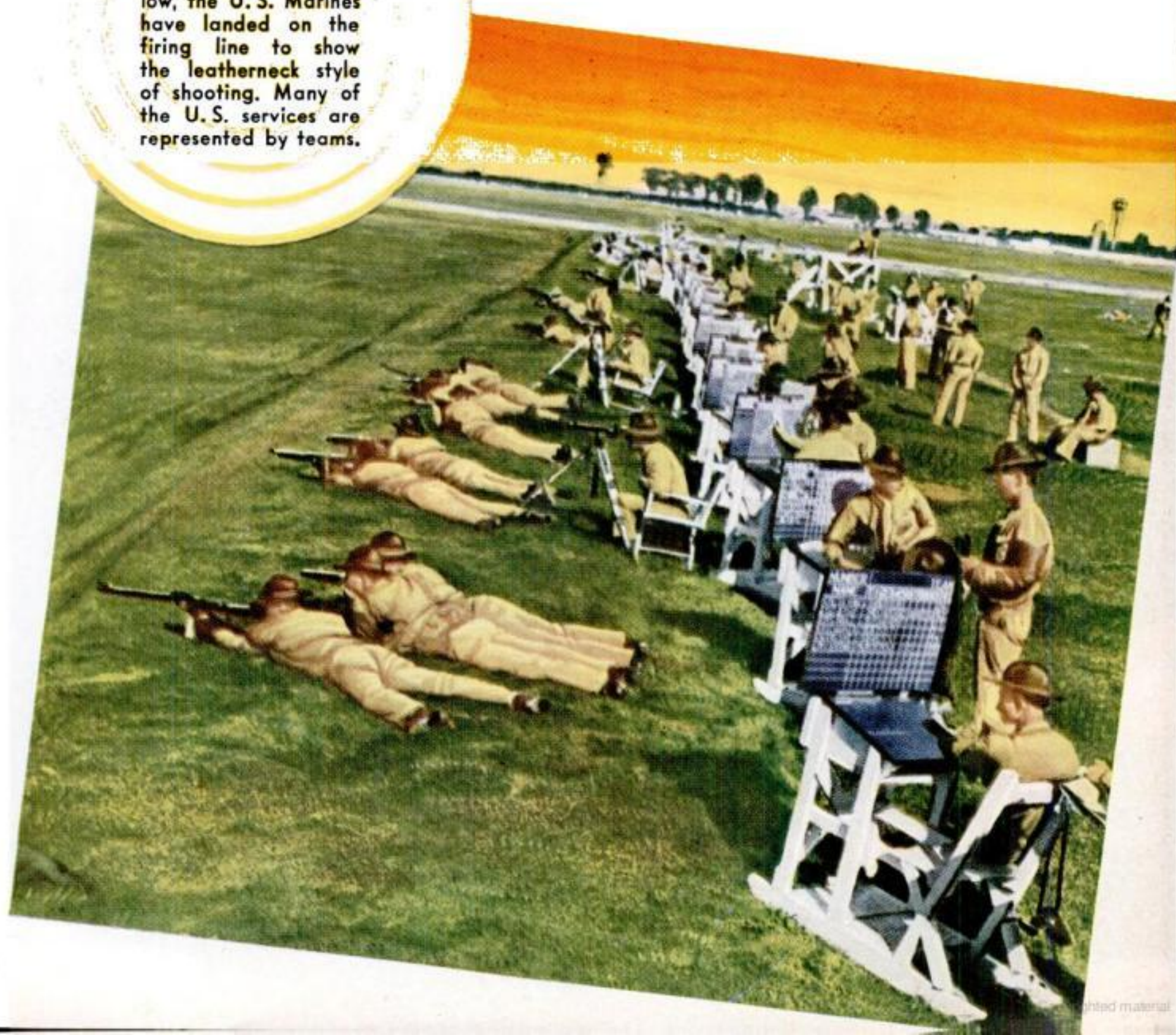
Group by group, all along the firing line,

Arms and the woman: a trio of fair contestants. Whole families like the group below attend the matches—and they all shoot, too





An official at the microphone during the presentation of medals and trophies. Below, the U.S. Marines have landed on the firing line to show the leatherneck style of shooting. Many of the U.S. services are represented by teams.



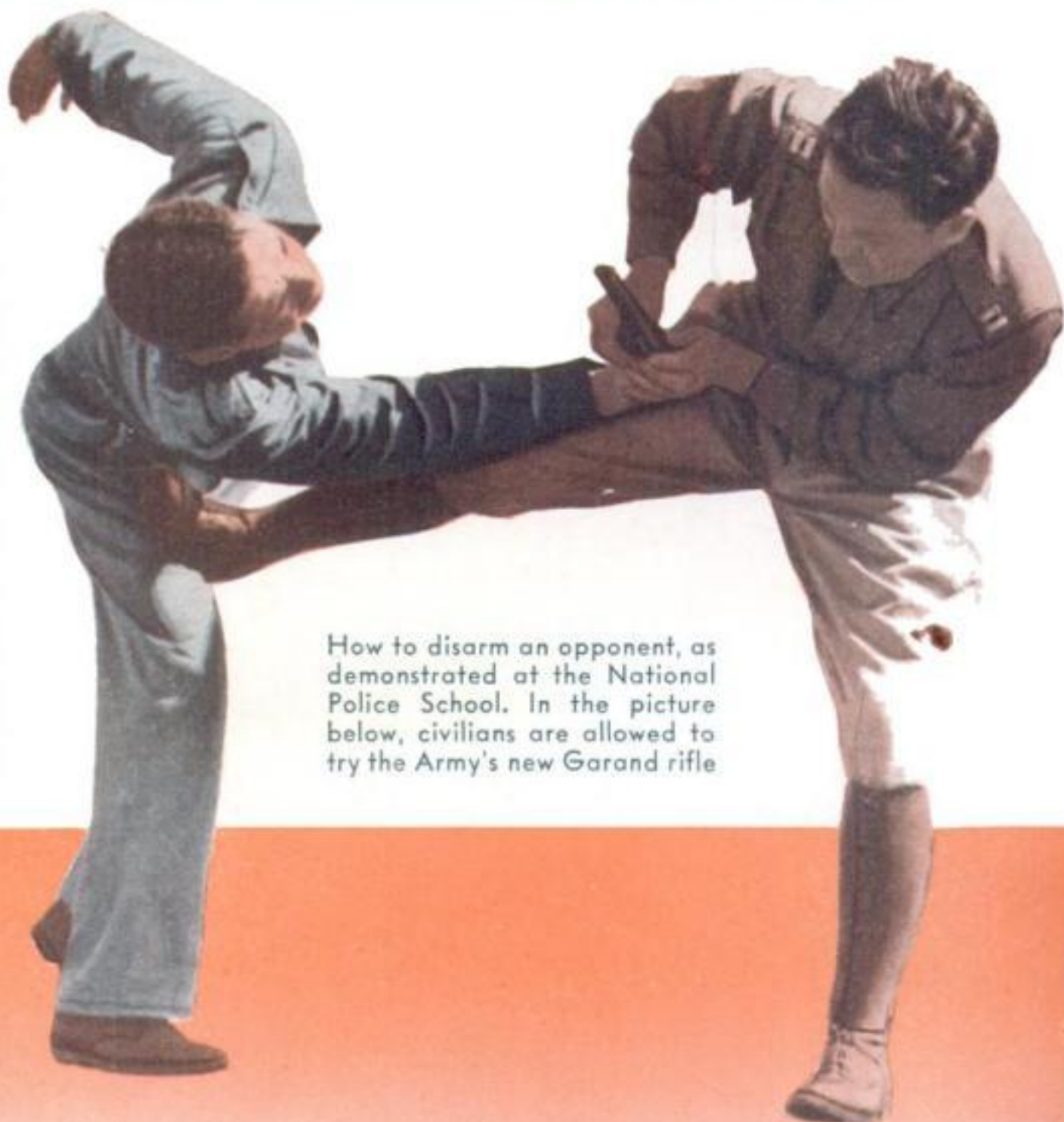
the nation's greatest shots, together with the dubs and rank tyros, are standing, sitting, kneeling, and lying prone, shooting rifles, pistols, and revolvers at various ranges, in timed-fire, rapid-fire, and slow-fire matches. Playing a sharpshooter's swing tune, bullets whistle through the air and zing into the targets, or occasionally kick up a spatter as they miss the target and plow into the waters of Lake Erie beyond the butts.

Strolling down back of the firing line, or sighting along the pits behind the targets, you'll marvel at the horde of Army officers and men needed to conduct all phases of the competition. You'll note target spotters, range officers, scorers, checkers, computers, and messengers. In the pits, the trench back of the butts, you'll watch enlisted men haul targets down from their racks in the line of fire, for checking, repair, and replacement.

Officials estimate that fifteen Army men are required for each ten contestants in order to run the matches in the smooth, efficient, and safe manner for which the meet is famed. An indication of how Army supervision makes for safety is found in the fact that only two casualties have

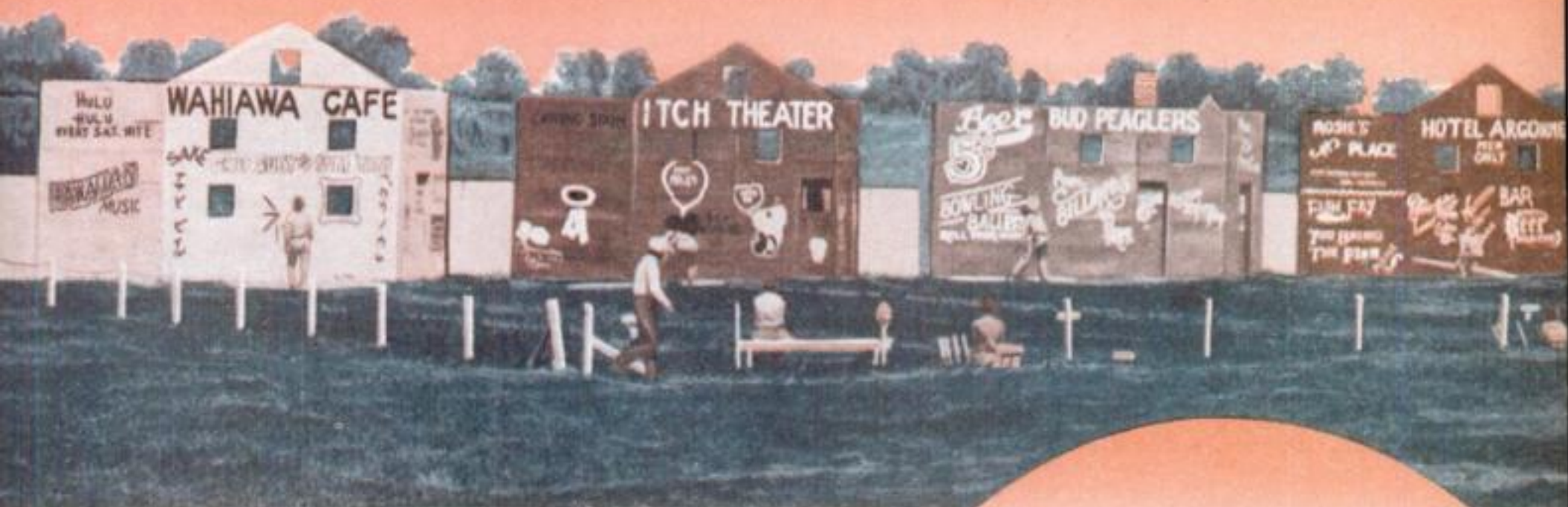
occurred in twenty-one years of match firing at Camp Perry.

Down at the left of the range, you'll witness one of the most interesting phases of the Perry matches—the National Police School, where representatives from police departments in all sections of the country are schooled in the latest methods of police science, and sent back home as qualified instructors to their fellow officers in the home forces. Subjects studied in the full-week course include disarming an attacker, shoot-



How to disarm an opponent, as demonstrated at the National Police School. In the picture below, civilians are allowed to try the Army's new Garand rifle





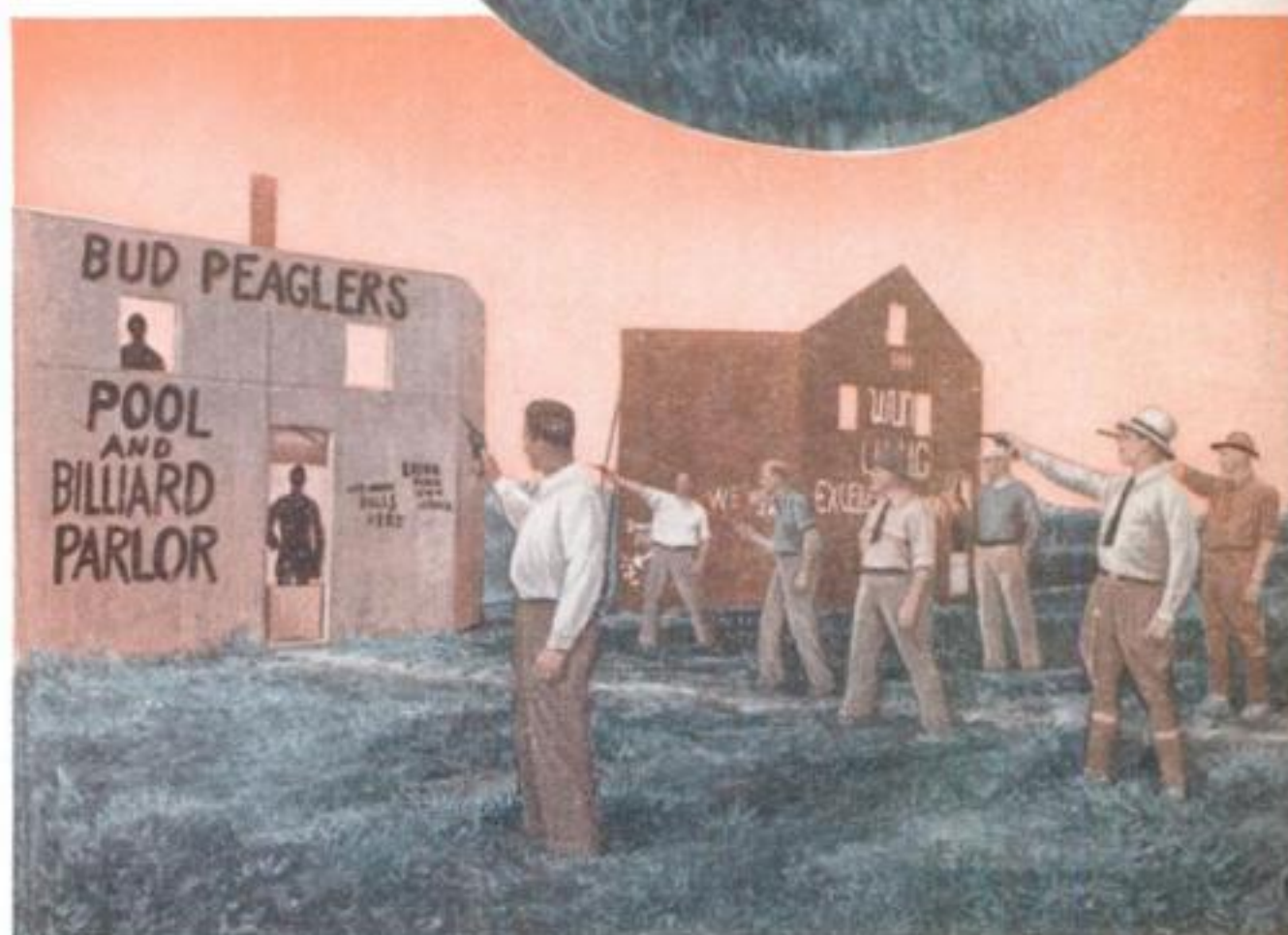
"Hogan's Alley," a feature of the Police School. Silhouette targets, controlled by levers seen at right, appear in windows of the dummy buildings

ing at rapidly disappearing targets, using tear gas and the Thompson submachine gun, hand-to-hand fighting, and the fundamentals of jujutsu.

Here at the Police School is the famous "Hogan's Alley," a curious group of backless building fronts representing the dilapidated frame structures lining one side of the main street of Bucktown Gulch, Ariz., as it appeared in 1879. By means of a series of hand levers and attached cables, silhouette figures are popped suddenly into the window or door openings of "Bud Peagler's Pool Parlor," or the "Wahiawa Cafe," while police try to drill them with pistol bullets before they disappear two seconds later.

Near-by is a replica of the rear of an automobile. Traveling on an overhead trolley, it speeds away as police fire at it in attempts to "blow" a rear tire. Similar in operation is a running-man target, which crosses the officers' line of fire at an angle from left to right.

The value of this police training is dramatically revealed by the experience of the Detroit, Mich., police who have sent representatives to the school for years. When they first started, an average of four policemen lost their lives for every criminal killed in Detroit. Today, the average is one policeman to every eleven criminals.



A hot gun battle in the Alley. Since the targets appear unexpectedly and vanish in two seconds, it takes good shooting to hit one

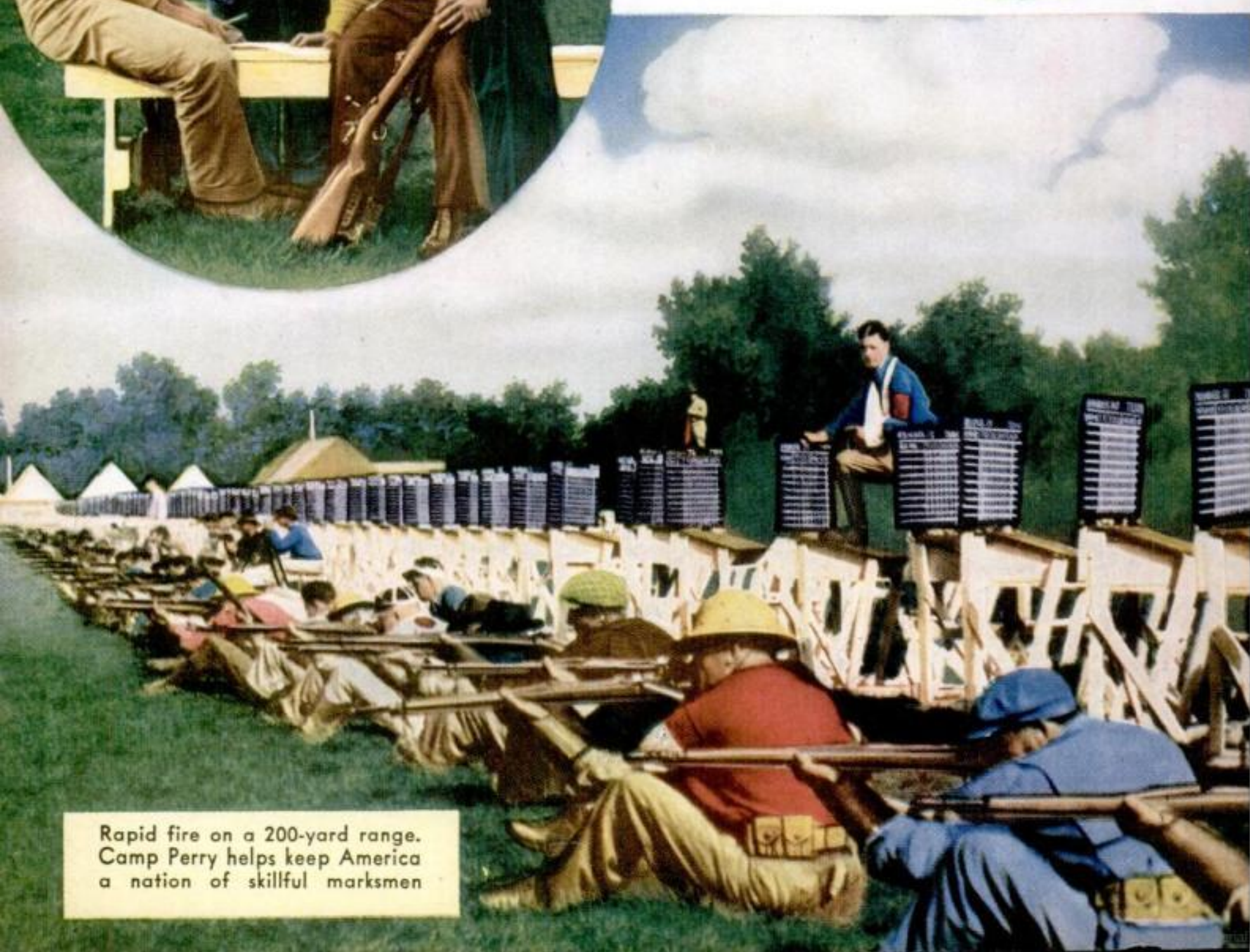
At the opposite end of the range from the Police School you run across hundreds of youngsters from eight to eighteen, some of whom will shoot it out for the national jun-

ior championship of the nation, and some of whom are barely big enough to hoist a rifle to their shoulders. A U. S. Marine is assigned to each of these neophytes to give him expert instruction in the rudiments of rifle shooting and gun handling. Before the youngster comes out from under the wing of his leatherneck guide, he will have learned not only how to shoot a gun and handle it safely, but also how to clean it, take it apart, and put it back together again.

Truly a giant training ground for the de-

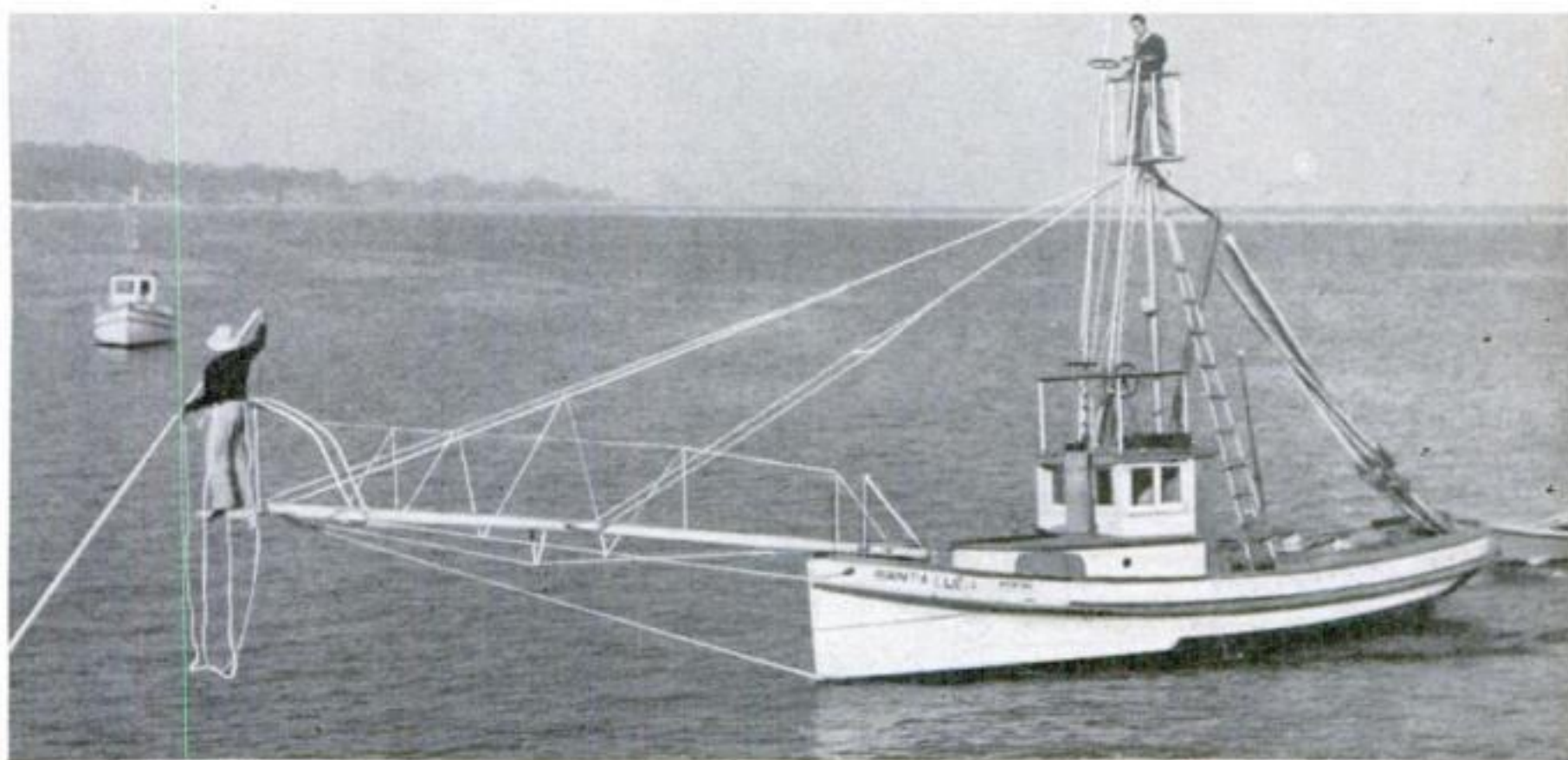
velopment of the art of shooting, in all its phases from the instruction of future sharpshooters to the rewarding of record-breaking feats of marksmanship, the annual Camp Perry meet has had much to do with the establishment of shooting as one of the most popular American sports. And now, with national defense of primary importance, Perry's influence may prove to have been of even greater value than that of a clean, wholesome sport in building up the armed might of the United States.

Queer gadgets like the balancing device at the right appear at every meeting. The boys below are learning all about guns from a U. S. Marine



Rapid fire on a 200-yard range. Camp Perry helps keep America a nation of skillful marksmen

Fishing Boat Steered from Crow's Nest



When the lookout sights a school of fish, he can run the vessel toward it by controls atop the mast

ONE man can act both as pilot and lookout aboard the fishing boat *Santa Lucia* of Santa Barbara, Calif. In the crow's nest of the vessel, two control wheels are connected

by means of long rods with the steering mechanism and engine below. The pilot can thus steer his craft toward any school of fish he sights from his lookout.

Motor Conversion Unit for Bicycles



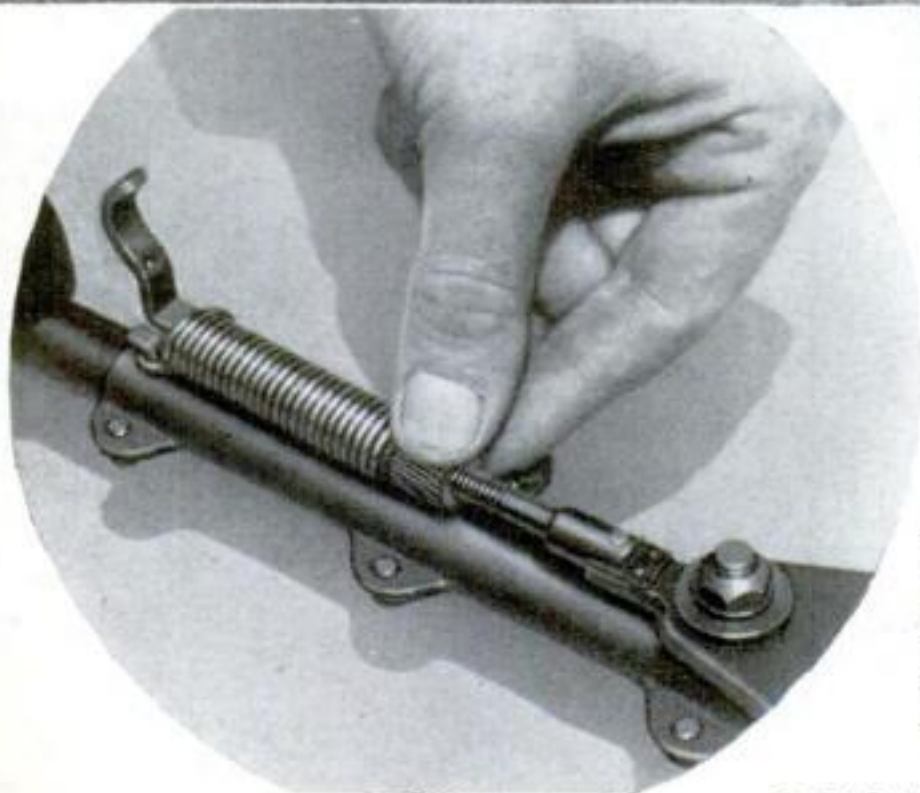
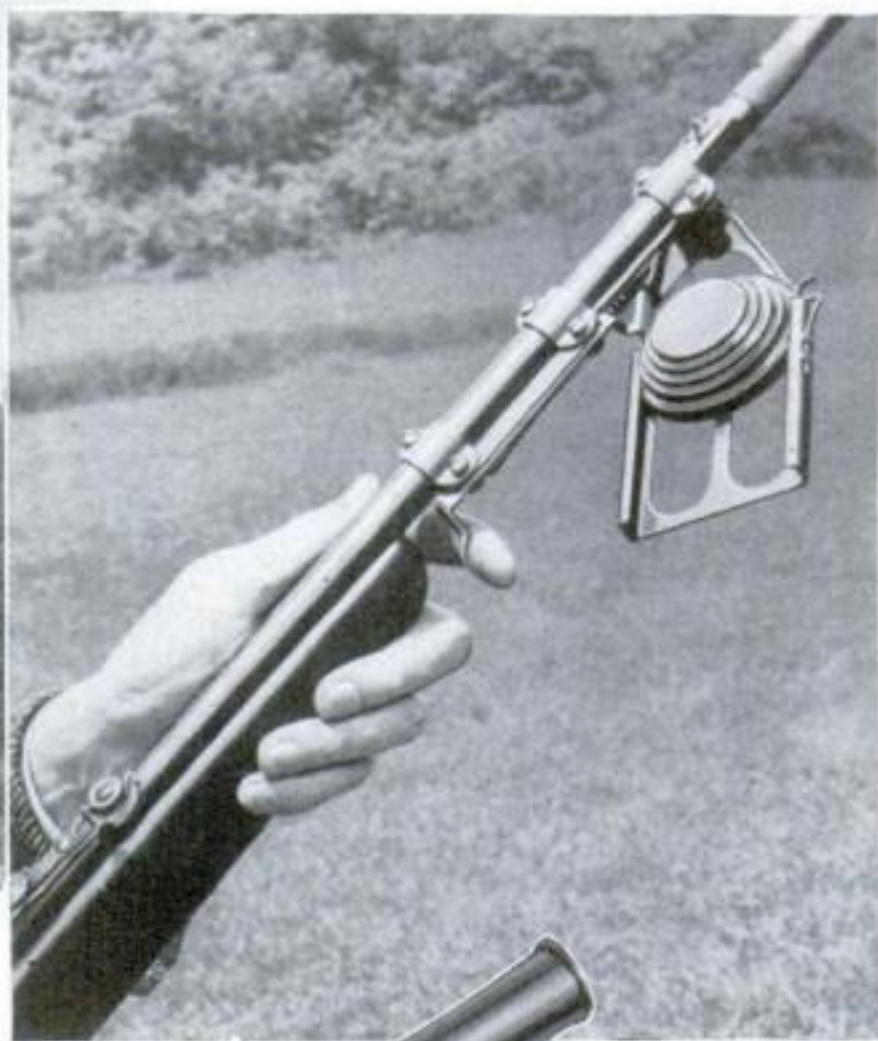
No more pedaling with this converted motor bicycle. The luggage compartment is seen above

BICYCLES can be converted into motorized vehicles by means of easily installed units just introduced. The rear wheel of the bicycle is removed and replaced by the unit pictured at the left, which includes an engine, drive mechanism, small rear wheel, and special luggage compartment. Rated at one and a half horsepower, the four-cycle, air-cooled motor is equipped with a kick-type starter and drives the wheel at speeds up to thirty miles an hour, running more than 100 miles on one gallon of

gasoline. Power is transmitted to the rear wheel by means of a specially designed drive incorporating a chain and V-belt transmission to reduce road shock and vibration. Clutch and throttle are operated by finger-tip controls on the handlebars.

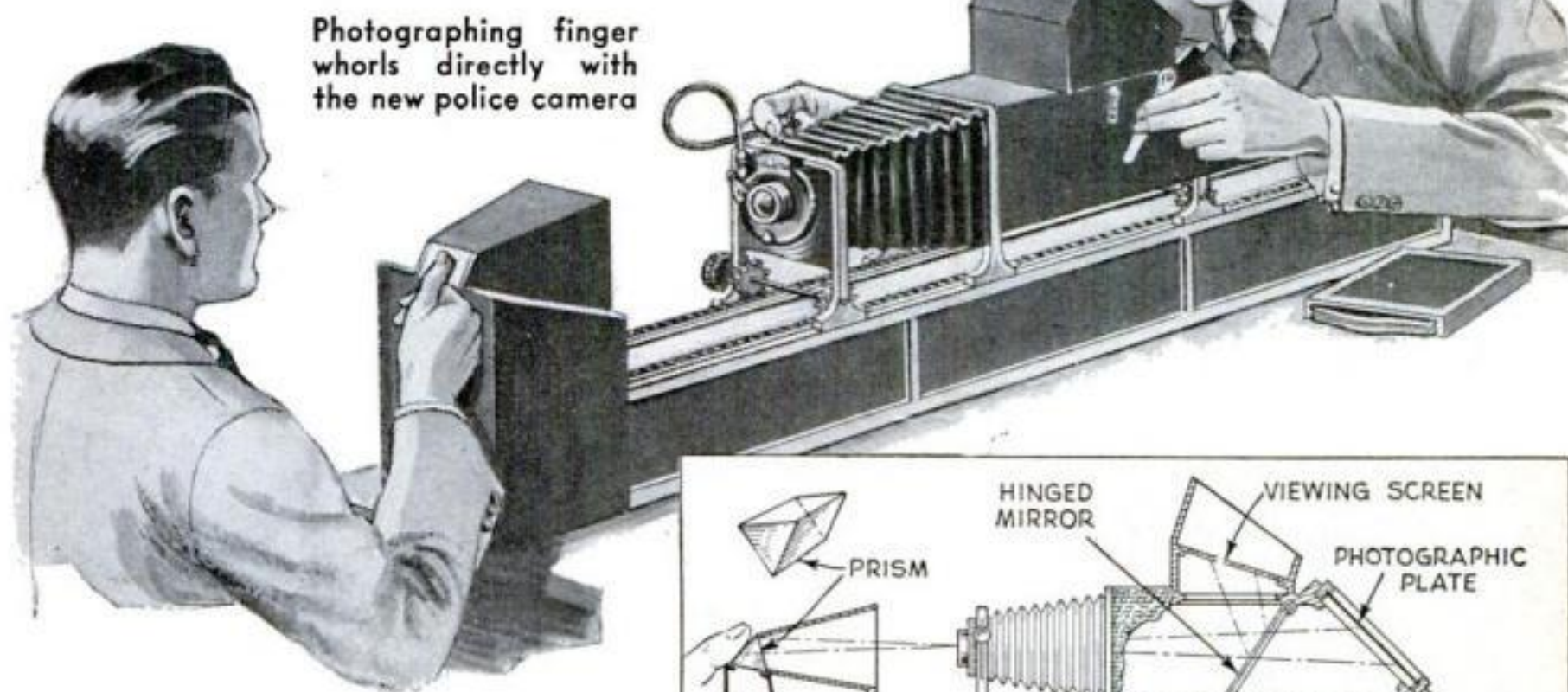
Trap on Gun Hurls Clay Targets

WEIGHING only fourteen ounces and clamping to the barrel of almost any .22 caliber smoothbore or .410 shotgun, a simple spring trap for throwing small clay targets makes possible an exciting new shooting game. The forefinger of the left hand presses the target release, sending the clay disk skimming away, while the forefinger of the right hand operates the trigger of the gun. At a distance of fifty feet the tiny pellets of a .22 long rifle shot shell will break one of the clay disks. According to the inventor, I. O. Mossberg, of New Haven, Conn., such one-man trap shooting can be practiced safely in any 300-foot open field, since the range of the shot is short.

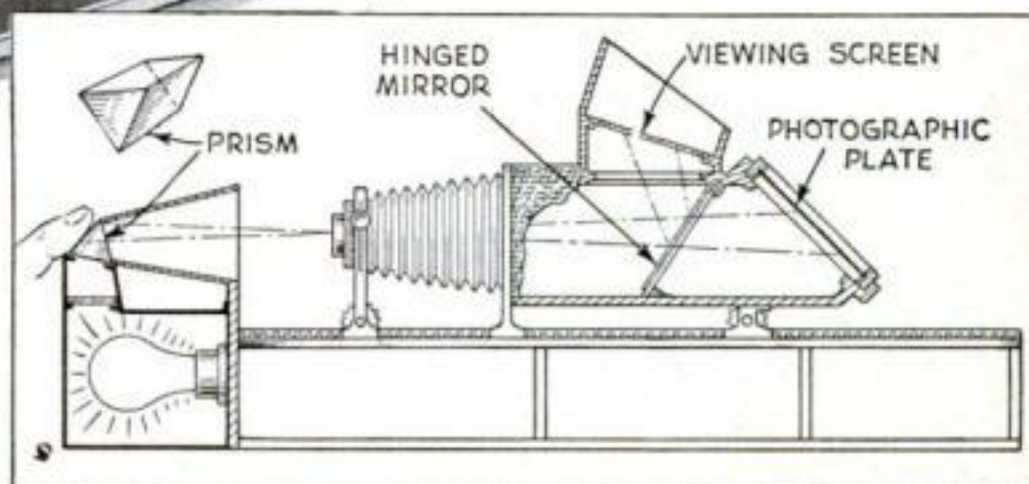


Any open field becomes a trap-shooting range with this new game for sportsmen. Above, how the trap is attached to the gun barrel, and scatter-shot shells used with a .22 caliber smoothbore. Trap spring can be adjusted for speed and distance, as illustrated at left

Camera Puts Fingerprints Directly onto Film



TO IMPROVE fingerprinting technique, a Worcester, Mass., inventor has developed a special camera to photograph fingers directly to obtain prints. The subject places a finger against one side of a prism set into one end of the apparatus. Light from an electric bulb in a special housing shines into the prism and reflects the finger image through the lens of an adjustable reflex-type



How a built-in light illuminates the telltale print pattern

camera for focusing and photographing. Side lighting brings out details of the print clearly, while by eliminating the need for an inking pad, the apparatus removes the danger of smeared prints.

Bank Teller's Cage Has Fourteen Ways To Foil Holdups

NO MATTER what tactics a robber may attempt, the teller in the special bank cage pictured at the right has a card up his sleeve to foil him. Installed in the demonstration room of a company manufacturing protective devices for banks, stores, warehouses, and other places of business, the cage is equipped with fourteen separate electrical devices, most of which are hidden and capable of secret operation while the teller apparently obeys the orders of his armed "customer." In the photograph, the teller is shown operating an alarm button under the counter with his left hand while handing over cash with his right.



By pressing a concealed button, the cashier gives the alarm



Pouring shot into the funnel, a little at a time, Tyrrell pulled the weighted pencil along the tablet with a piece of string

Is It Murder?

By
EDWIN TEALE

AT FIVE minutes past eleven, on the night of April 18, the crash and rumble of an elevated train muffled the quick double report of a revolver on the upper floor of a New York rooming house. The next morning, a housekeeper found the bodies of a man and woman sprawled on the floor, both shot through the head. Between the two, where it appeared to have dropped from the stiffened fingers of the man, lay a blue-barreled, .32 caliber revolver. Appar-

**How Scientific Sleuths
Uncover Hidden Clues
to Trap Clever Killers
Who Plot "Perfect Crimes"**

ently, the tragedy was a murder and suicide.

That is the way the verdict might have stood, but for one of the newest strings to the bow of scientific crime detection. In New York City, as part of their regular procedure, detectives now obtain blood samples at the scene of every crime of violence. In this instance, such samples quickly erased "suicide" from the report and left the one ominous word: "murder."

A laboratory detective, skilled in the use of serums, studied the blood samples with test tube and microscope. As a result of recent research at the Rockefeller Institute, and in other laboratories, seventy-two groupings of fresh human blood are now recognized under the four main types: A, B, AB, and O. Through the reaction of specimens and serums, the detective ascertained that the woman had type B blood; the man type A. Samples of small, fresh stains on the floor of the death room, however, gave an entirely different reaction. They had been produced by type O blood and could not have come from the life stream of either victim. A third, unknown, injured person had been in the room on the night of the tragedy!

That laboratory clew set detectives of the homicide bureau digging into the past lives of the victims. Under questioning, a rival for the affections of the woman confessed he had gone to

the room, had been slashed in a quarrel, and had shot both the man and woman. Then, after wiping fingerprints from the revolver, he had planted it to suggest a suicide.

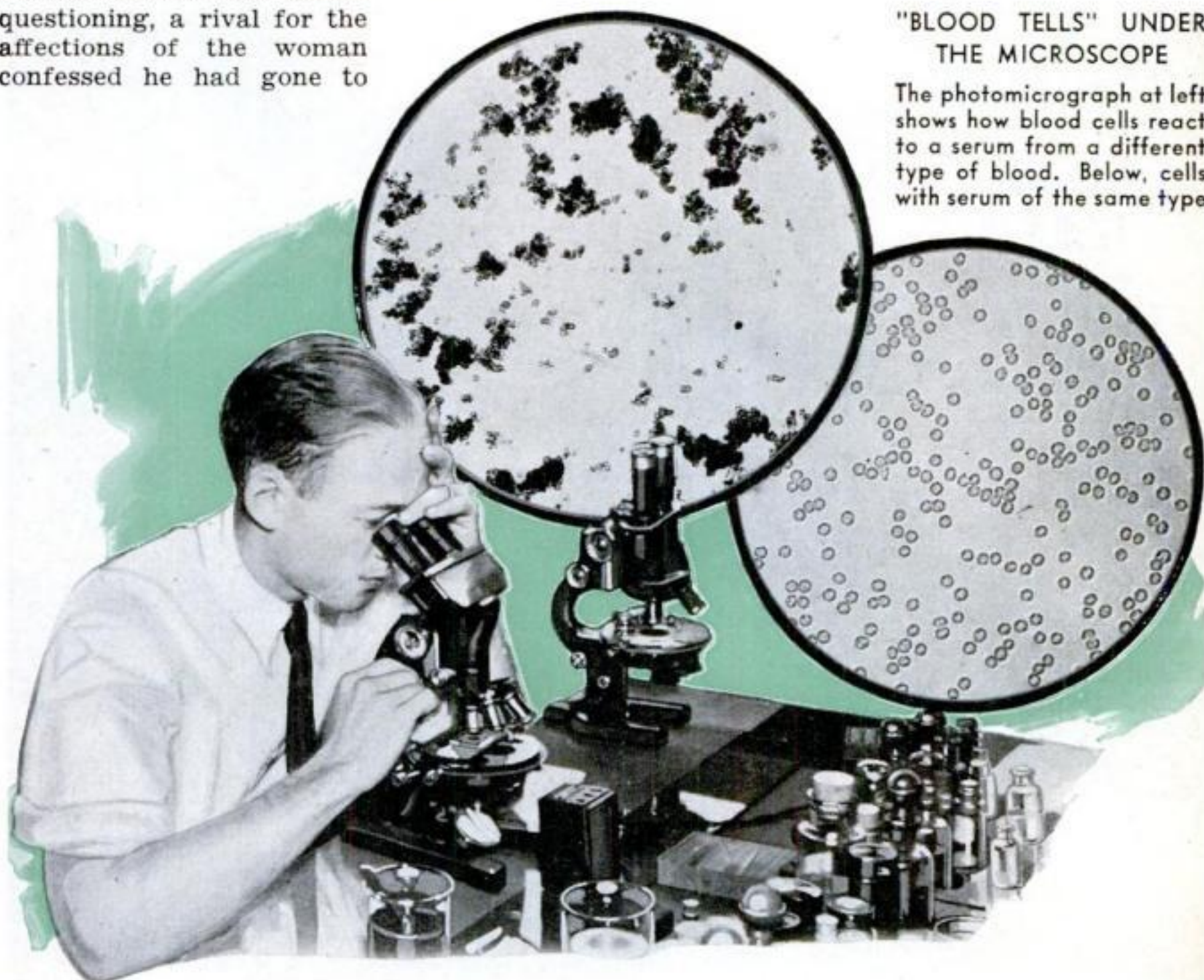
Oftentimes, cunning and cold-blooded killers seek to hide their crimes by such a ruse. Exposing these murders disguised as suicides is one of the dramatic jobs of the scientific sleuth.

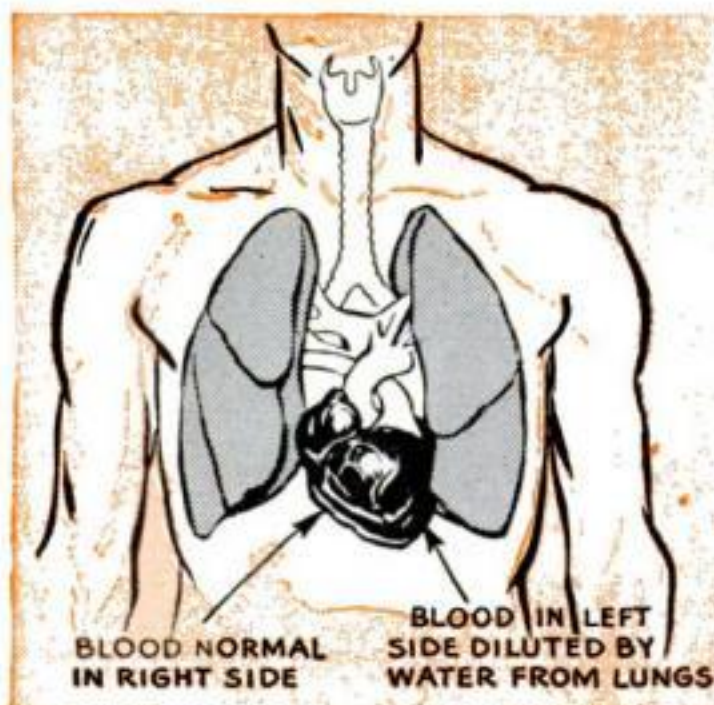
In this work, present-day crime fighters are making use of many of the resources of science. They are putting paper, hair, rope, handwriting, fingerprints through a scientific third degree. They are employing spectroscopes to reveal the presence of metals and drugs. They are using polarized light to make crystal patterns stand out vividly under the magnifying lens. They are operating comparison microscopes to bring the images of two bullets or bits of metal together so that scratches can be compared. In some instances, the reaction of chemicals placed on a victim's hand has proved he did not fire the weapon he held. In other cases, a comparison of revolver-barrel markings on bullets showed that the victim was killed by another pistol rather than the one found clutched in his hand.

The old expression, "Blood will tell!" has been given a new twist by present-day crim-

"BLOOD TELLS" UNDER THE MICROSCOPE

The photomicrograph at left shows how blood cells react to a serum from a different type of blood. Below, cells with serum of the same type





DID DROWNING OCCUR IN SALT WATER?

By comparing the amount of salt in the blood in right and left sides of the heart, scientific detectives can determine whether a drowning victim died in fresh or salt water. This test often unmasks criminals who have "planted" a body in order to counterfeit a suicide

crowded street below to hide his crime.

One of the most ingenious advances in recent criminology is a blood test devised by the noted New York toxicologist, Dr. Alexander O. Gettler. It tells almost infallibly whether a drowning victim met his death in salt or fresh water. From the lungs, blood goes directly to the left side of the heart where it is pumped through the circulation system

inology in unraveling mysteries of simulated suicide. Even the tiniest drop of this vital fluid is often enough to reveal important clues that will lead to a solution.

A few months ago, noon-hour shoppers in a midwestern city screamed and scattered. The body of a man had plunged from an upper-story window of an office building. It hurtled downward and struck the sidewalk. The first doctor to reach the scene pronounced the man dead, evidently a suicide.

Three hours later, this simple explanation was shattered by an alert assistant at the local morgue. He had noticed that there was no blood in the lungs, a condition characteristic of deaths by falling. The implication of that discovery was plain. The victim had been dead before the fall from the office window. A swift police investigation followed. It revealed that a dissolute business associate after killing the victim, had pushed the body from the window. He had relied upon the spectacular plunge into the

of the body, returning to the right side of the heart. Normally, this blood contains a certain percentage of salt. When drowning occurs in sea water, the lungs fill with brine



Investigation revealed that a business associate killed the man and threw his body from the window

before death takes place and the salt content of the blood on the left side of the heart is increased. When death occurs in fresh water, this blood is diluted and so contains less than the normal amount of salt. Simply by taking samples from both sides of the heart and determining the salt content of each, the scientific sleuth now can prove instantly, in suspicious cases, whether death occurred in salt or fresh water. In other drowning cases, microscopic water-borne clues have been instrumental in spotlighting murder plots disguised as suicides.

FOR example, a few years ago, boys out hunting gophers entered an old barn standing in a hayfield near a river. Within, they found the body of an elderly man hanging from a crossbeam. All evidence pointed toward a suicide until a scientific detective set to work with his microscope. Beneath the victim's finger nails and in his lungs, he discovered diatoms, or subvisible algae found in fresh-water streams and ponds. This clue—too small for human eyes to see—provided a key that unlocked the mystery of an amazing murder. The elderly victim had been drowned. Then his clothes had been changed and his body hanged in the barn in what his slayers imagined was a complete obliteration of all evidences of their guilt.

Sometimes the microscope joins forces with the test tube in exposing a suicide slaying. In Ohio, not long ago, a woman was found dead, poisoned by arsenic. Her husband contended that she had taken her own life, and exhibited a half-empty box of vermin eradicator which he said she had used. About this time, evidence came to light that, a week before, he had purchased a different type of this same deadly poison. Had the victim met her death by taking the rat poison, as he said, or had he murdered her with the arsenic he had bought? The answer hinged on tiny crystals found in the stomach of the victim. The test tube proved they were arsenic. Under polarized light, the microscope next revealed brilliant, triangular facets entirely different from those in the vermin compound. Tripped up in his story, and confronted with this evidence, the slayer confessed.

In the drug-crazed mind of an eastern dentist, some years ago, there hatched one of the most diabolical poison plots in the annals of premeditated murder. His father-in-law had taken out life insurance in his favor. To collect this money, the dentist pretended to fill a large cavity in one of the older man's teeth. Packing it full of the



To collect insurance, a dentist filled a cavity with a deadly poison, covering it with a temporary wax coating

deadly drug aconite, he covered it with a thin, temporary filling. During the night, this filling dissolved and the victim died in agony before morning. The indication, as the murderer expected, was that the dead man had taken his own life. In analyzing the stomach content, however, a toxicologist discovered minute fragments of undissolved dental wax. Suspicious, he instituted an investigation. It resulted in the slayer's conviction.

To save precious minutes in dealing with Borgia killers, scientific detectives in several large cities now employ spectroscopes to analyze unknown poisons. In a fraction the time required for chemical tests, such mechanisms enable them to determine the drug that caused death. In the spectroscope, each chemical element produces its own distinctive lines of color.

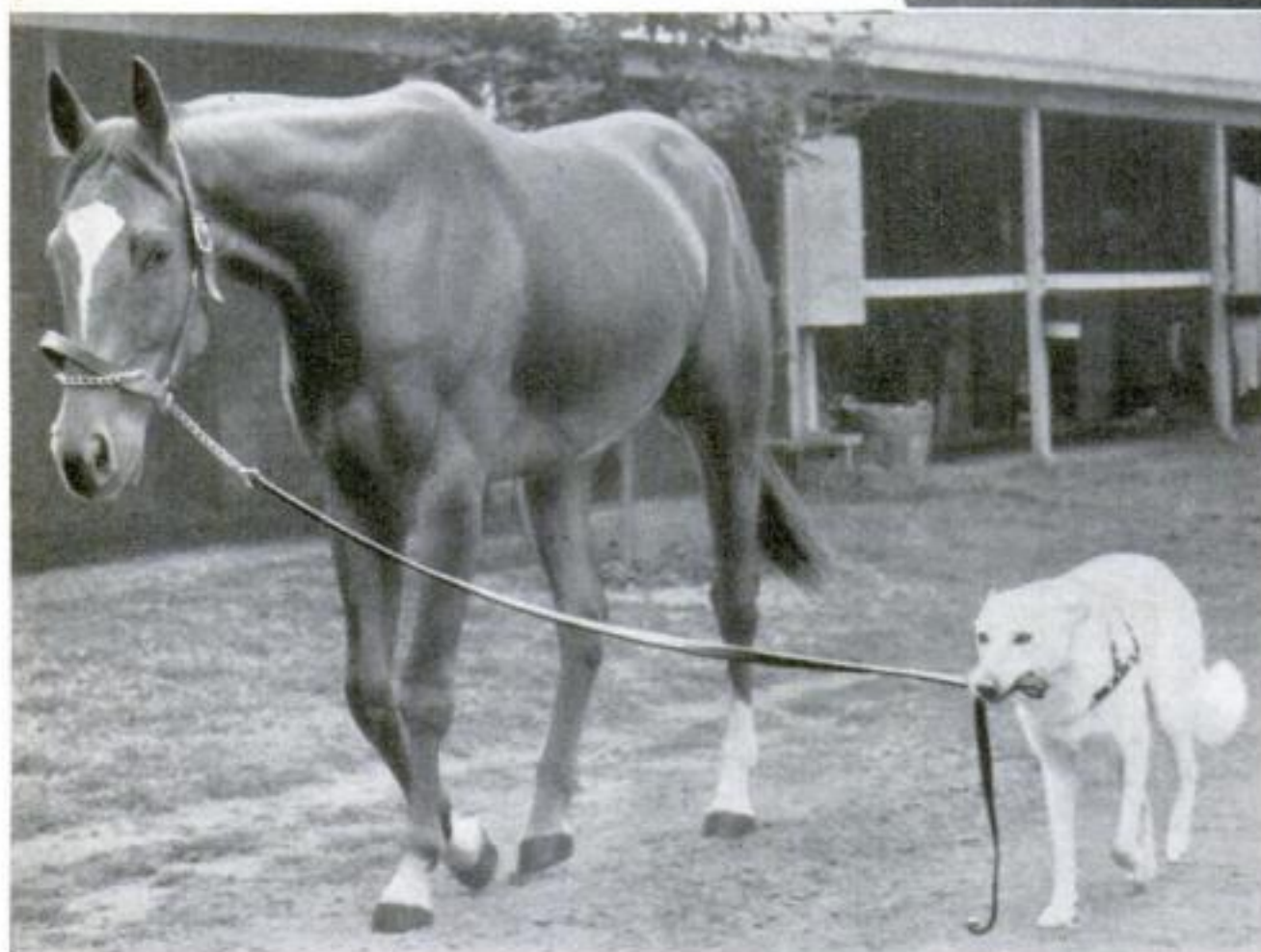
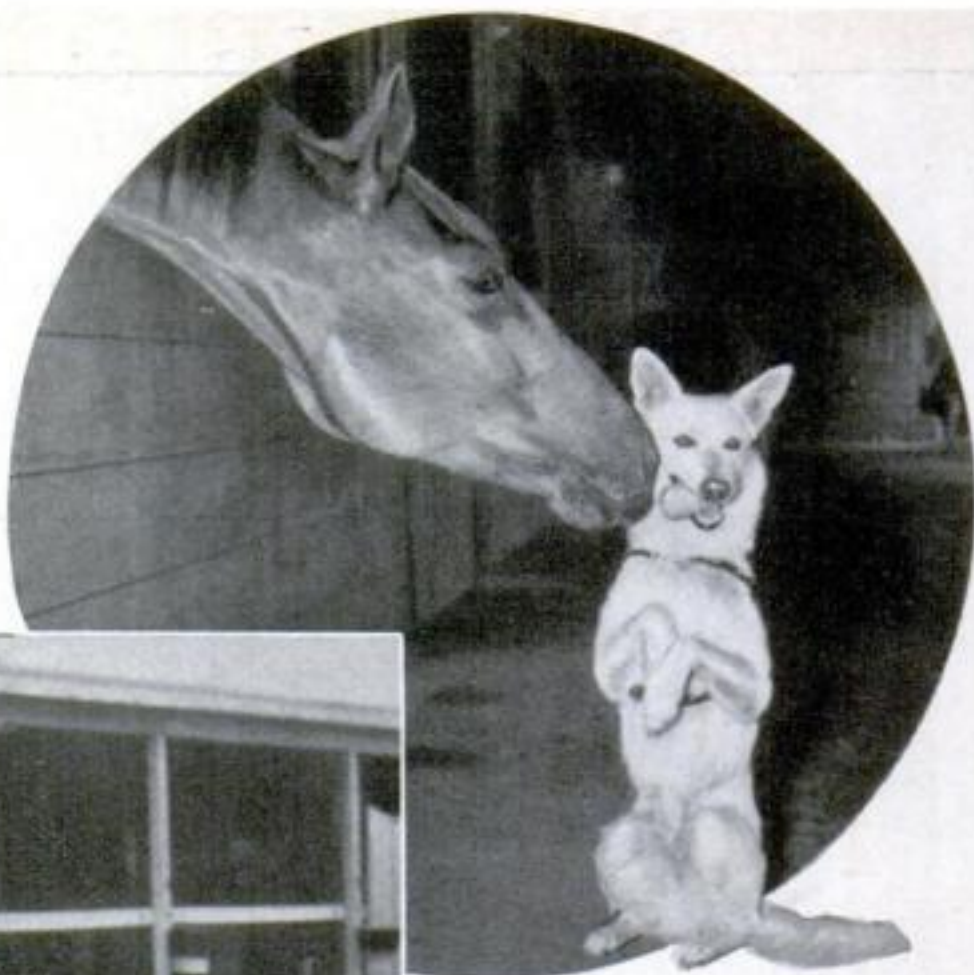
IN ADDITION to spectroscopes, to polarized light, to the more elaborate tools of scientific crime detection, the investigator on the trail of a fake-suicide slayer often has to devise original apparatus of his own to prove his point. An outstanding instance of the kind occurred during the celebrated "phantom will" case at Ladysmith, Wis.

Shortly after a wealthy widow remarried, she died of poison. Her husband brought forth one of the strangest documents ever offered as evidence in a law court—a combined suicide note and will which had been written neither

(Continued on page 221)

Canine Stable Boy Helps Train Racer

HIGH-STRUNG, temperamental race horses often have mascots, whose playful companionship provides a diversion from the serious business of winning turf events. Witness, for example, the friendship of Baranca, a thoroughbred, and Flash, a pure-white dog. In the circle at the right, the



Flash, the dog mascot, leading Baranca out for a walk. In the circle at upper right, the race horse is accepting a carrot from his canine friend

trained mascot offers the racer a juicy carrot, and at left, he holds the halter and leads Baranca out for a light workout, at their Inglewood, Calif., home. Winner of his share of races, the horse could lead the dog a merry chase if he chose to set the pace instead of meekly obeying the "orders" of his affectionate canine trainer.

Pioneer "Seeing Eye" Dog Is Preserved

ALMO, said to have been the first police dog brought to this country as a "seeing eye" for the blind, has been preserved as in life for his master, Dr. W. A. Christensen, of Hollywood, Calif. When the animal died, John M. Schleisser, California naturalist, first measured him, both before and after the skin was removed. Next, he modeled Almo in clay, made a cast over the clay, and inside this cast molded a form of papier-mâché. Then he fitted the skin, which had been tanned and mothproofed, over the form. Finally he returned the original jawbone and teeth to the mouth. Wearing his harness, as shown at right, Almo now looks as alive as when he trotted across Hollywood street intersections ahead of his master.



FIELD TRIALS TEST

Champion Hunting Dogs



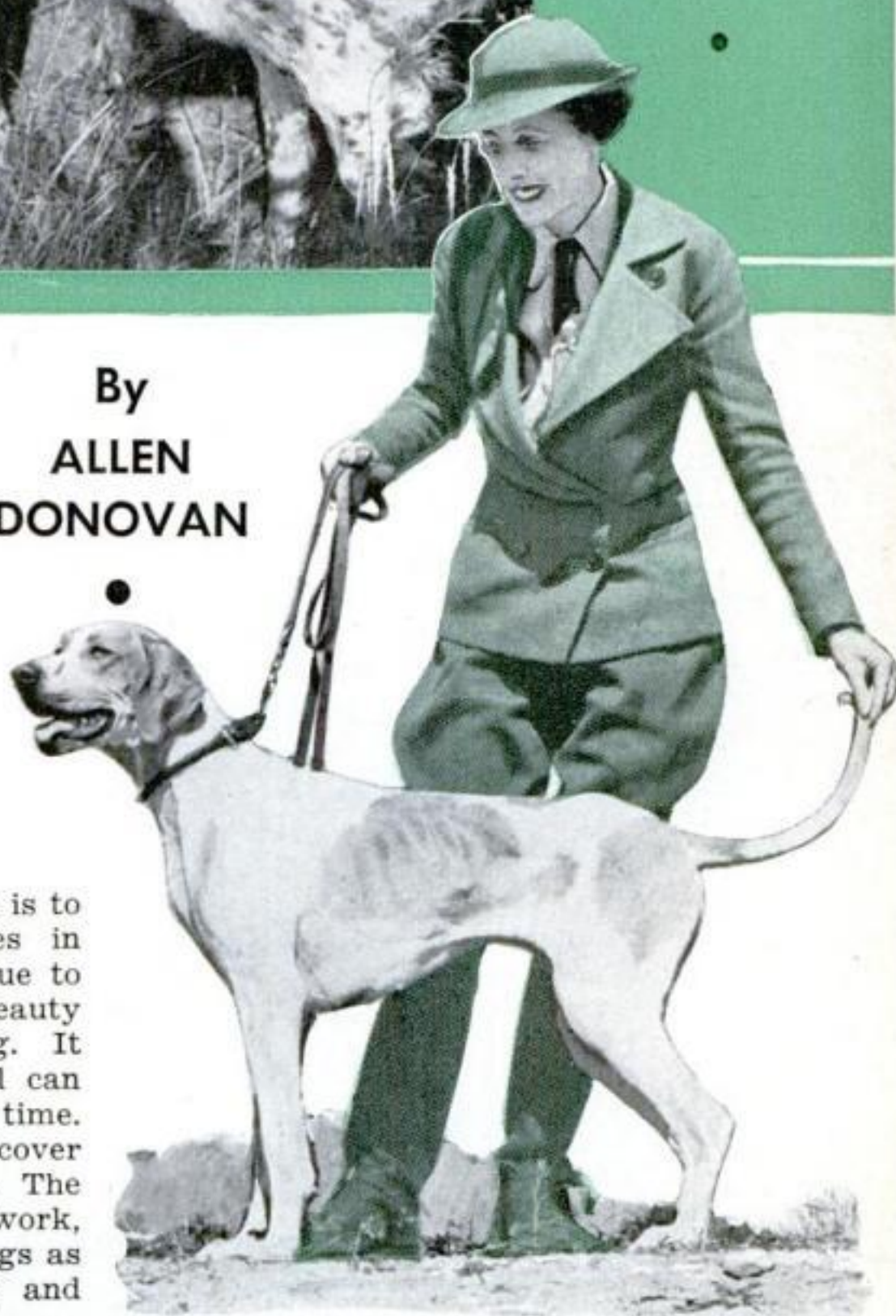
Two hunting dogs, a pointer and a setter, "freeze" on a game bird. Correct form in pointing requires head and tail to be above the line of the back, as illustrated below

SIXTY-SIX years ago, on the eighth of October, the first American field trials for hunting dogs took place near Memphis, Tenn. Today, sporting calendars record such events in all parts of the country. Annually, hundreds of thousands of spectators watch various breeds of dogs, such as pointers and setters, beagles, basset hounds, dachshunds, foxhounds, spaniels, and retrievers, compete under varying rules for honors and awards.

The whole purpose of a field trial is to determine which animal possesses in the highest degree qualities of value to the hunter. A field trial is not a beauty contest to pick the handsomest dog. It is not a race to see which animal can cover a given course in the least time. It is not even a competition to discover which dog can find the most game. The judges, watching the animals at work, list their ratings under such headings as speed, stamina, style, intelligence, and courage.

Usually, the dogs compete in packs or in braces, which consist of two animals running at the same time. They have from half an hour to three hours in which to cover a given area and find or retrieve game which

By
**ALLEN
DONOVAN**



has been released beforehand. The manner in which the dogs handle themselves in the field is the basis of the judges' decision. Centuries of breeding and years of scien-

tific training combine to produce the winners.

The earliest dogs to compete in American field trials were pointers and setters, animals which rigidly point toward game as soon as they scent it. Such contestants are still among the favorites of field-dog fanciers. To watch these hunting dogs in action, I recently drove to Clinton, N. J., where the Jockey Hollow Club was holding one of its celebrated field days for field dogs.

Two black-and-white pointers were zig-zagging through the weeds when I drove up to the 1,000-acre, state-owned shooting grounds. In this type of competition, the dogs hunt for pheasants or quail released on the course. At Clinton, the three-mile circuit ranges through open fields, along a bush-covered hillside, through heavy woods and out onto a lowland meadow cut by a winding stream. Handlers direct the dogs while the judges follow close behind on horseback.

Along the hillside, the black-and-white pointers cut sharply back and forth while the handlers called them in or urged them out with sharp blasts of their whistles. One blast usually means "Come in!", two blasts "Go on!" To eliminate confusion, handlers often use whistles of different pitch.

While the dogs are working westward through bril-

liant-hued bushes, the judges are jotting down their notes, watching especially such points as thoroughness and scenting ability. The latter quality is of prime importance.

A few years ago, a brilliant young pointer in the South won fourteen victories in a single season. He seemed destined to become one of the greatest dogs in field-trial history. Then, at one contest, an insufficient number of kennels was provided. The young dog was kept overnight in a garage and during the evening, someone carelessly ran a motor. The fumes from the exhaust affected the delicate nose of the pointer, ruining its career.

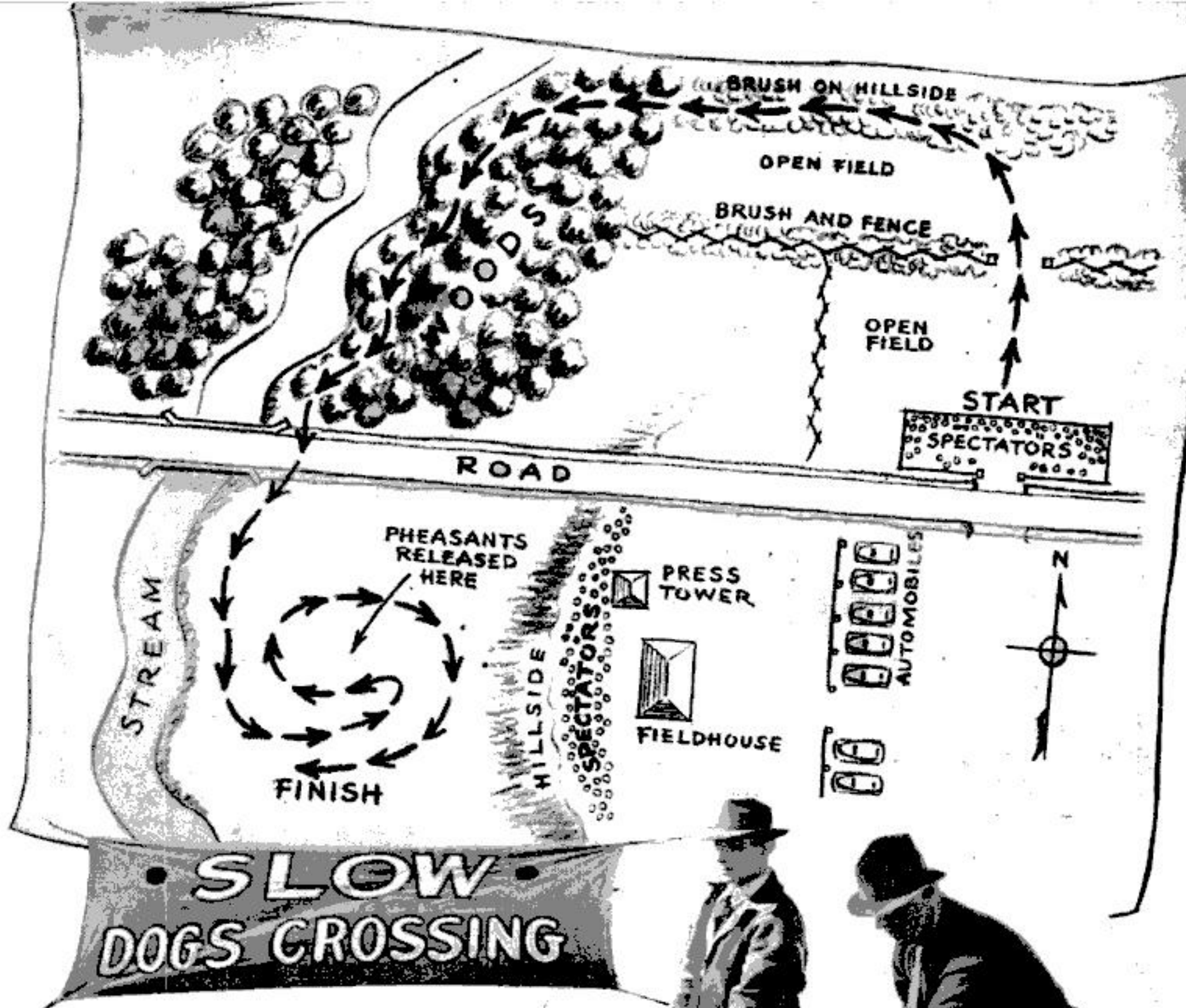
Some dogs, trainers have found, are "too fast for their noses." They continually "bump" birds, scaring them into the air by

For field trials, pheasants are released from cages like this. Pulling a rope opens the door and the bird comes out to hide



HOW TO MAKE A BIRD DIZZY

Sometimes pheasants are tied in patches of brush for dogs to find. To make them stay quiet, they are first made dizzy by tucking their heads under their wings and whirling them around, as shown at the left



Map of a typical course on which hunting-dog field trials are held. Signs warn motorists at the road crossing. Right, a brace of dogs ready to start the hunt for game

running too close before they detect their scent. In field trials, a slower, keener-nosed rival is likely to win over such a competitor.

A "bump" may be accidental. But a "flush" is not. In this more serious defect the dog points at the invisible quarry and then slowly walks in until the bird flies up. Even worse is what is known as "blinking." The animal scents the bird but goes on without pointing, ignoring or "blinking at" the fact that the bird is there. Blinking is fatal in a contest. So is "interference." Here the dog cuts back and forth in front of its rival or rushes in and flushes a bird at which the other dog is pointing.

How long a bird dog will remain rigidly pointing at the spot where he scents game is a question hotly debated among sportsmen. At one recent meet, a trainer lost sight of his dog. He "hit" him again and again with



blasts of his whistle. Finally, after thirty-five minutes of searching, he discovered the animal standing rigid among thick bushes, pointing at a clump containing game birds.

The distance at which such dogs can catch the scent of the quarry depends upon weather conditions as well as the direction of the wind. Some years ago, in England, a noted dog trainer named H. M. Budgett made exhaustive tests of *(Continued on page 217)*



Here's My Story



1 DAVID SARNOFF SPENT THE FIRST NINE YEARS OF HIS LIFE IN WEST CENTRAL RUSSIA, WHERE HE WAS BORN ON FEBRUARY 27, 1891



2 WHEN HE WAS NINE YEARS OF AGE, HE CAME WITH HIS FAMILY TO THE UNITED STATES. YOUNG DAVID WAS THE ELDEST OF FIVE CHILDREN



3 THE DEATH OF HIS FATHER A FEW YEARS LATER MADE HIM THE FAMILY BREADWINNER, SO HE STARTED SELLING NEWSPAPERS IN DOWNTOWN NEW YORK CITY



4 TO SUPPLEMENT THE SMALL AMOUNT HE MADE SELLING PAPERS, HE GOT A JOB AS MESSENGER BOY FOR THE COMMERCIAL CABLE COMPANY



5 FINALLY, HE LANDED A FULL-TIME JOB, AT \$5.50 A WEEK, AS A MARCONI COMPANY OFFICE BOY. AT NIGHT, HE PRACTICED CODE ON AN OLD SECONDHAND TELEGRAPH SET



6 IN 1908 HE GOT HIS FIRST ASSIGNMENT AS A WIRELESS OPERATOR, IN THE LONELY MARCONI STATION ON NANTUCKET ISLAND, OFF THE COAST OF MASSACHUSETTS. HE SPENT HIS SPARE TIME IN THE STATION LIBRARY, READING TECHNICAL BOOKS

THE INSPIRING CAREER OF DAVID SARNOFF



7
HE WANTED TO STUDY ELECTRICAL ENGINEERING AT PRATT INSTITUTE IN NEW YORK, SO HE ASKED FOR A TRANSFER TO THE SEAGATE, N.Y., STATION. THIS MEANT A \$10 CUT IN SALARY, BUT SHORTLY HE WAS PROMOTED TO STATION MANAGER



8
WHEN HE WAS TWENTY YEARS OLD, HE SERVED AS WIRELESS OPERATOR ABOARD THE *S.S. BEOTHIC* ON A SEALING EXPEDITION IN THE ARCTIC



9
IN 1912, AS A NEW YORK MARCONI STATION OPERATOR, HE PICKED UP WORD THAT THE *S.S. TITANIC* WAS SINKING. HE STAYED AT HIS KEY FOR 72 HOURS AND GAVE THE WORLD THE FIRST AUTHENTIC NEWS OF THE DISASTER



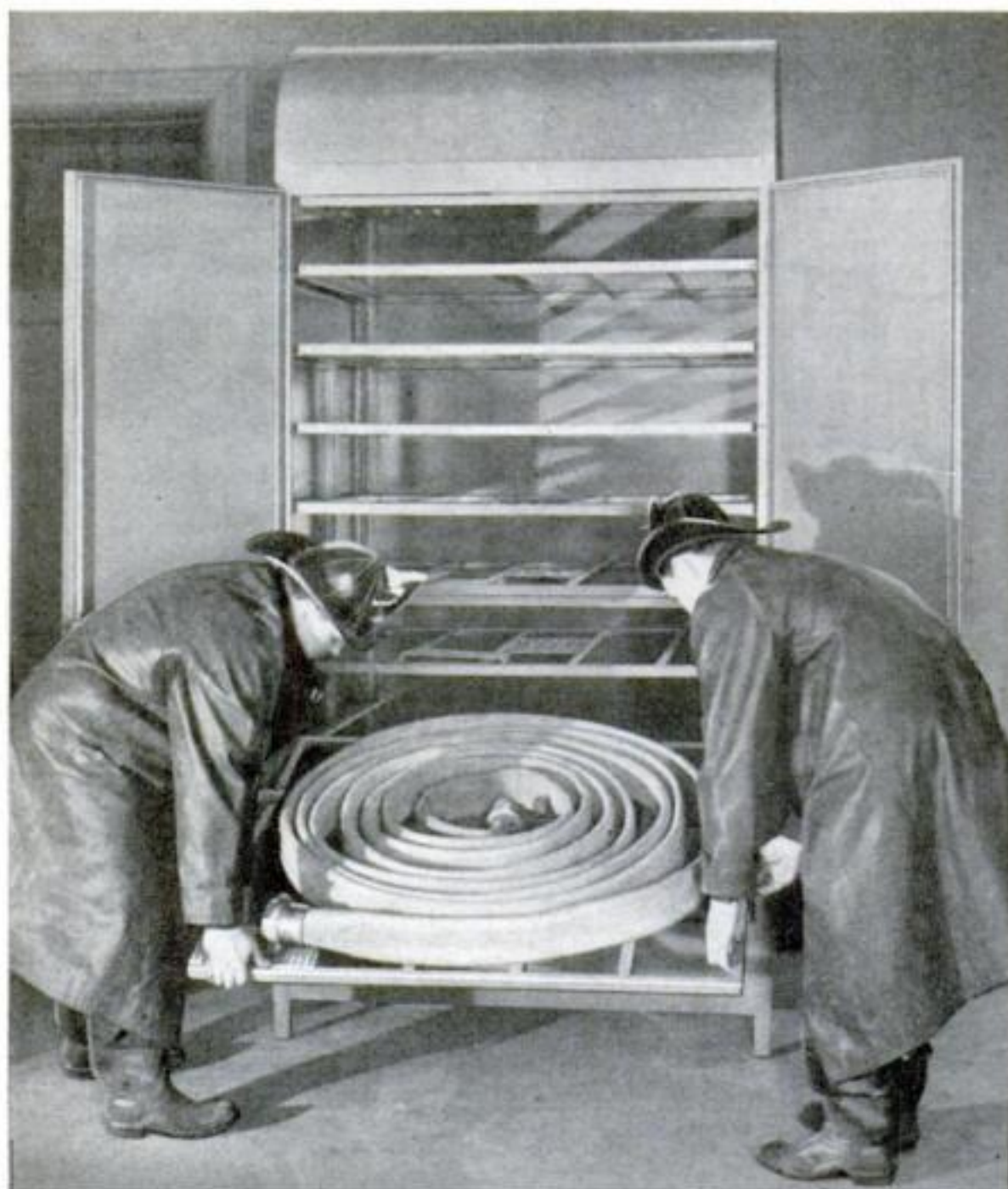
10
WHILE COMMERCIAL MANAGER OF THE MARCONI COMPANY IN 1915, HE RECOMMENDED DEVELOPING A "RADIO MUSIC BOX." THIS TURNED OUT TO BE THE FORERUNNER OF OUR MODERN HOME RADIO RECEIVERS



11
IN 1919, THE RADIO CORPORATION OF AMERICA ABSORBED THE MARCONI COMPANY, AND SARNOFF WAS MADE COMMERCIAL MANAGER OF THE NEW, ENLARGED CONCERN



12
AT 39, DAVID SARNOFF BECAME PRESIDENT OF RCA. TODAY HE ALSO HEADS THE NATIONAL BROADCASTING CO., IS A DIRECTOR OF THE METROPOLITAN OPERA AND OTHER IMPORTANT ORGANIZATIONS, AND HOLDS MANY HONORARY UNIVERSITY DEGREES



Hot-Air Cabinet Dries Fire Hose

AN AIR-CONDITIONED cabinet of new design makes short work of drying fire hose. Drawn into the machine, air passes over electric heaters and then circulates through the loosely coiled hose resting on shelves. The indirect heating is said to avoid possible damage to the hose, and the unit saves the time and work of hanging it up in a drying tower.

Fountain Pens Kept Clean by Chemical Bath

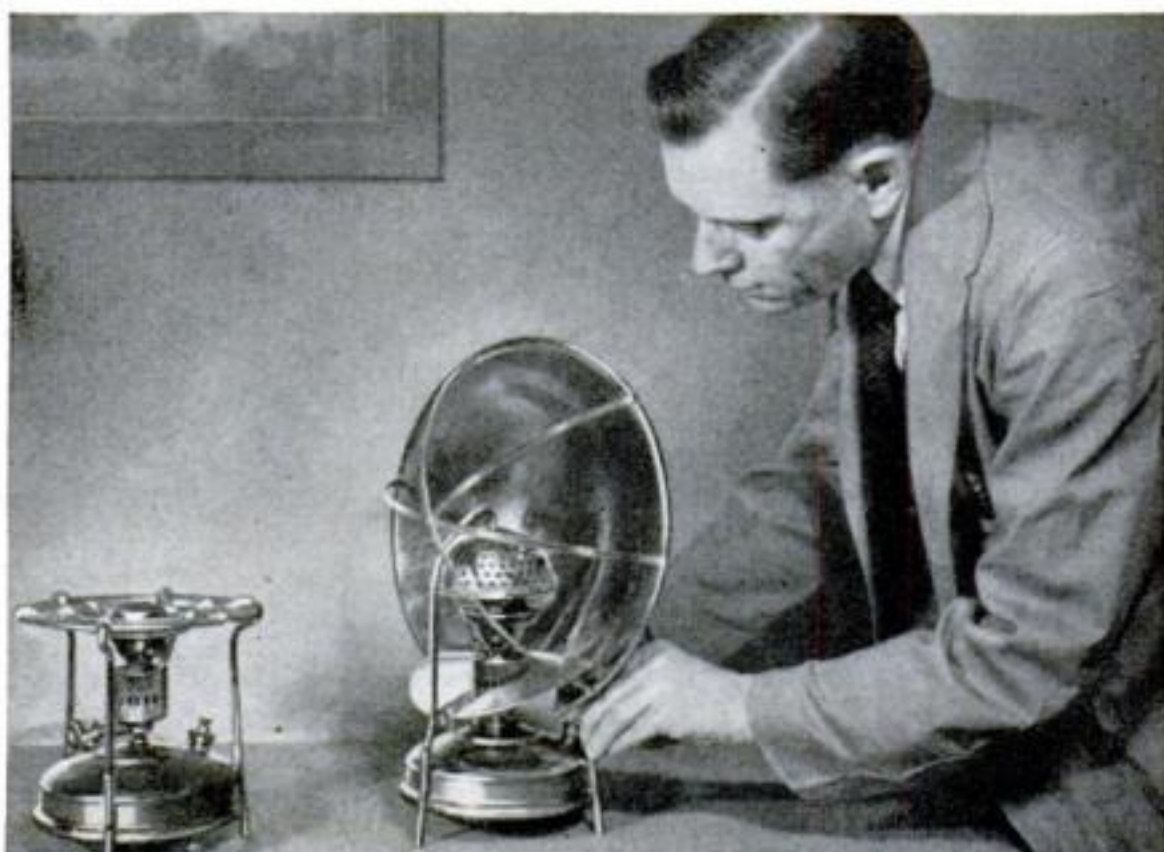
CHEMICAL "baths" for fountain pens are claimed to clean the parts and keep the rubber sacs in good condition. When a measureful of the flaky, white cleaning compound has been dissolved in warm water, the pen is immersed in the solution, which is circulated through the interior by working the self-filling lever. A can of the cleaner holds enough for fifteen "baths."



Flushing a fountain pen in the solution of chemical in water

Oil Heater and Stove Combined

ESPECIALLY suited for cabins of small boats, where space is at a premium, a one-burner kerosene stove and a radiant heater have been combined in a single compact assembly. For use as a heater, the burner is fitted with a perforated iron ball, which becomes intensely hot. A concave reflecting surface concentrates the heat rays in the desired direction. In the accompanying photo, the convertible unit is shown as a stove and as a heater.



Attachments convert the oil stove at the left into a radiant heater

Flame Thrower Helps Fight Forest Fire



Mule loaded with portable outfit for starting back fires. It sprays flaming oil on grass or leaves, as illustrated above

A PEACETIME flame thrower to combat destructive mountain and canyon blazes, by setting back fires, has been perfected by U. S. Forest Service engineers at Santa Barbara, Calif. Using Diesel oil as fuel, the apparatus may be carried into threatened areas by truck, on muleback, or on a frame supported by two men. A small gasoline engine pumps the fuel through a forty-foot line to the nozzle. In a recent five-hour test, the machine sprayed forty-five gallons of oil, enough to start a back fire several miles long.

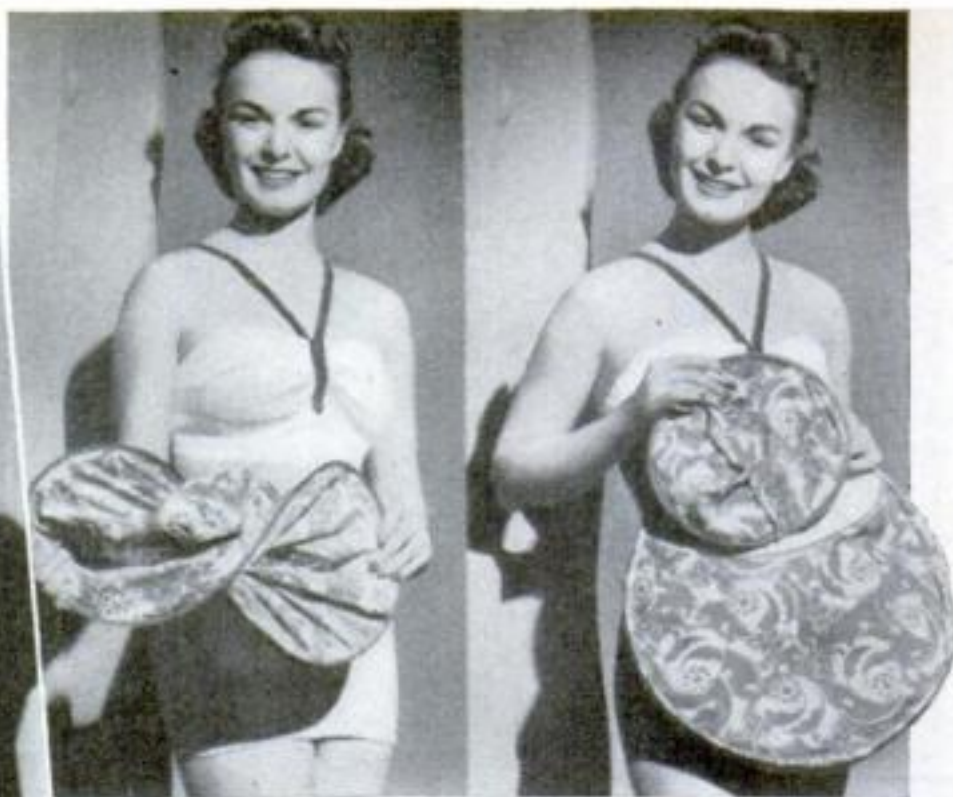
Addressing Machine for Home or Club

AN INEXPENSIVE new addressing machine serves homes, churches, clubs, and small businesses whose correspondence frequently goes to the same mailing list. Stencil cards, prepared on a typewriter, give as many as 10,000 impressions apiece. For use, up to sixty-five stencils are placed at once in a hopper at the left of the machine. The user then places each blank envelope in turn against a guide, uses a fingertip shift to flick a stencil into position beneath an inked roller, and depresses a printing handle. The method is said to produce neatly printed names and addresses at eight times the speed of hand addressing.



This device speeds addressing envelopes to mailing lists

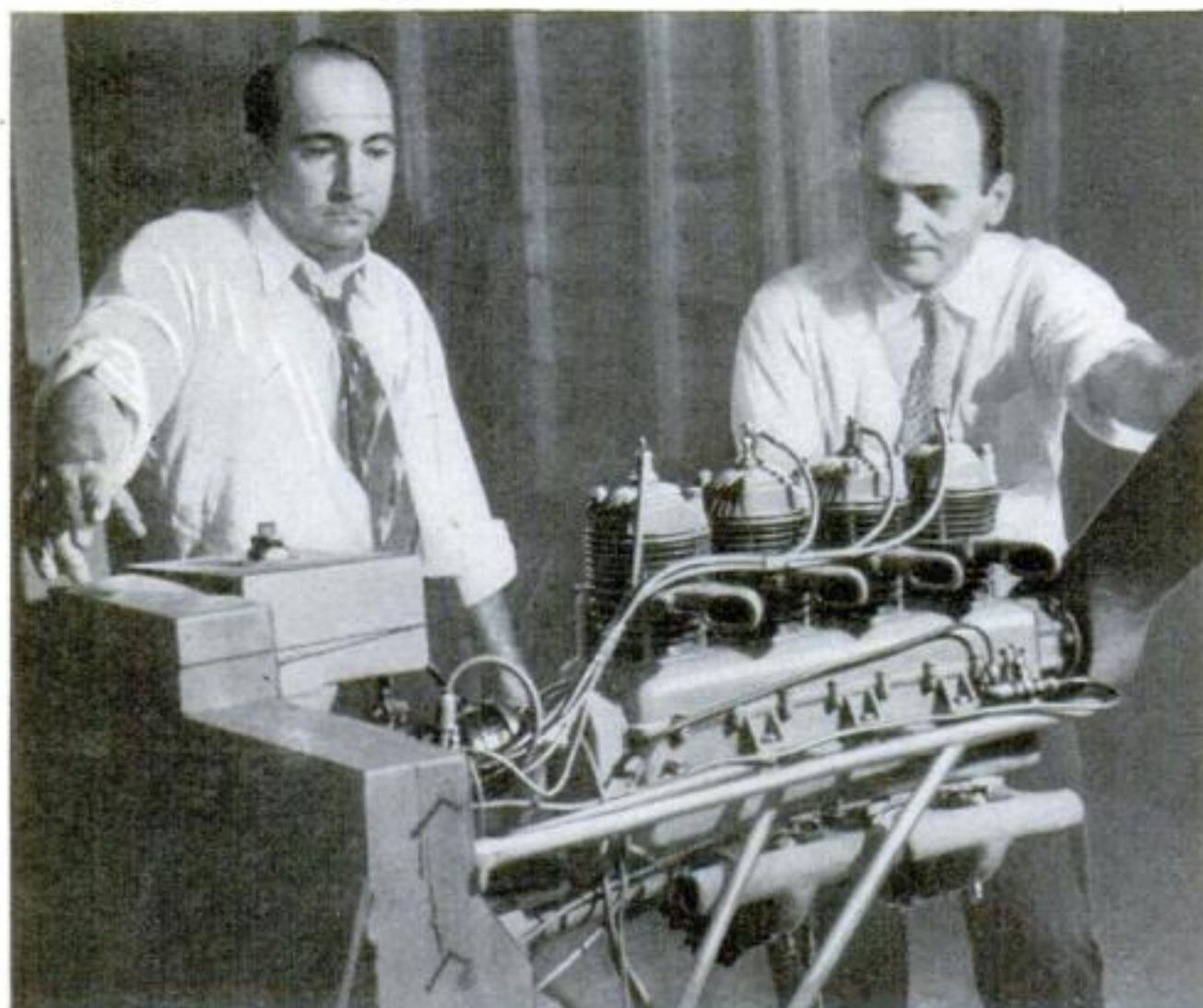
Beach Sunbonnet Is Collapsible



Folding up the beach sunbonnet shown in use at the left. It goes into a handy bag

SERVING as a beach umbrella in miniature, the new sunbonnet shown at left is collapsible. Upper views show how it may be tucked away when not in use by bending the flexible wire rim into a figure 8, folding over the loops, and slipping the pancake-shaped result into a handbag for beach accessories. The linen top that serves as a sunshade is available in a large variety of colorful patterns. Despite its wire frame, the hat is light in weight.

Lightweight Plane Motor Has Few Parts



Victor and Charles A. Toce with their simplified motor for airplanes

DISPENSING with a carburetor, a radical new airplane motor has been designed by Charles A. and Victor Toce, of Houston, Tex. Using half as many parts as a standard motor, they claim, it will develop twice the horsepower with the same displacement and less weight. In addition, they call their engine inexpensive to build and well suited to mass production. The two brothers have offered it to the U. S. Government, which recently has created a special board of experts to pass judgment upon the military usefulness of civilian inventions.

Transparent Clarinet and Mouthpieces



Clarinet mouthpieces of transparent plastic. Right, Paul Whiteman examines an instrument made of this material



IT'S easy to see where the music comes out, if you play a clarinet of transparent plastic material like the one being examined by Paul Whiteman, famous orchestra leader, in the photograph above. While the entirely transparent clarinet is still something of a novelty, mouthpieces of the

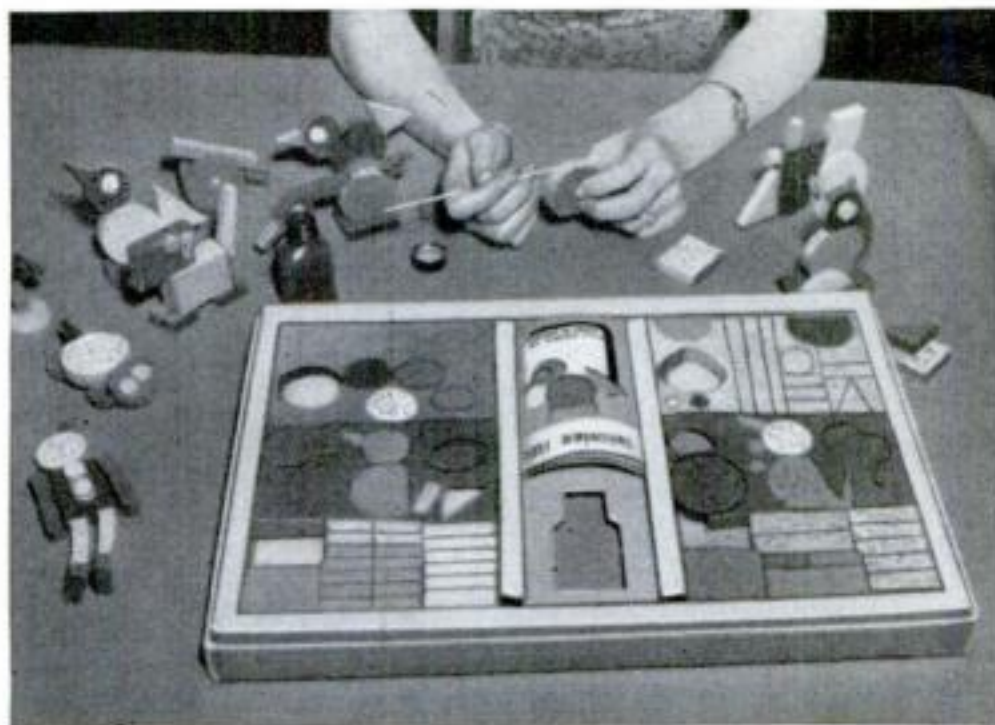
new material are now available to clarinetists for use with conventional instruments of wood or metal. Light in weight, the transparent plastic mouthpieces are said to be durable and proof against warping and splitting.

Electric Stop Watch Is Easy To Read

USABLE wherever it can be plugged into a 110-volt A.C. electric outlet, a novel electric stop watch has a counter like the odometer on your car. This makes it easy to read time in intervals as small as one tenth of a second up to 10,000 seconds, or about two hours and forty-six minutes. Pressing a button sets the timer back to zero.



Time is recorded on direct-reading counter



Sponge-Rubber Building Set

FIGURES of birds, animals, trees, trains, and other objects can be constructed from novel blocks made of sponge rubber. Put up in kit form with a supply of rubber cement and a wooden spreader, the die-cut rubber blocks are designed as an instructive and entertaining toy for children of all ages.

Paper Made from Clay



Dr. Ernst Hauser examining a sample of the "mineral paper" he developed. Above are materials from which it is made, bentonite from California (at top) and Wyoming



In one form, alsifilm can be used as a wrapping material instead of cellulose film or waxed paper

PAPER from clay, a remarkable new product for household, industrial, and war use, has just been developed at the Massachusetts Institute of Technology. While various kinds of it may be applied in familiar ways—as in transparent wrapping sheets and milk containers—the "mineral paper" is far more than a substitute for wood-pulp or linen paper.

In printing, its ultrafine texture imparts new clarity and detail to half-tone illustrations. Waterproof and nonabsorbent, it gives a much higher gloss than common paper. Unaffected by age, it may be employed for permanent records.

Its fibers can be made into filter cloth

Other uses: milk containers, threads, acidproof filter cloth, and molded parts for motors

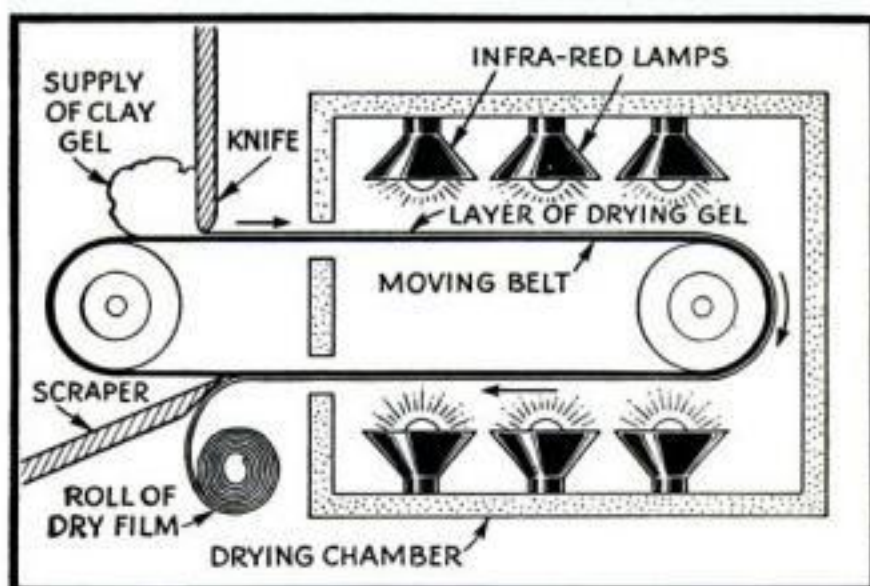


invaluable to chemical industries, because of its resistance to corrosive acids and alkalis. A flexible sheet form can be wrapped around electric cables for insulation.

For mica, a strategic war material used in electrical parts of autos, planes, and radios, the United States depends almost entirely on imports from abroad. Since the new clay paper has the same chemical composition and electrical insulating qualities, stiff sheets of it should make an admirable substitute.

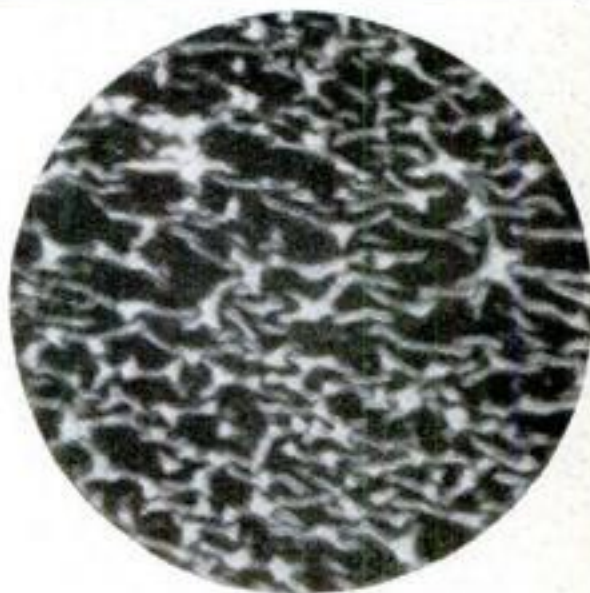
Called alsifilm, the new paper takes its name from the first letters of aluminum and silica. These are the constituents of Wyoming bentonite, a type of clay that serves as raw material for light-brown "mineral paper." Another kind of bentonite, from California, yields white paper.

Ground to fine powder, the clay is suspended in water while grit and foreign matter settle out. Evaporated to a jellylike mass, the residue then is chemically treated according to the desired use. Ultramicroscopic mineral fibers mat together during the process, as fibers of ordinary paper do.



PAPER FROM
COMMON
CLAY

How a prepared clay is turned into paper. The view at right shows the matted microscopic mineral fibers



Trucks Aid War on Mosquitoes

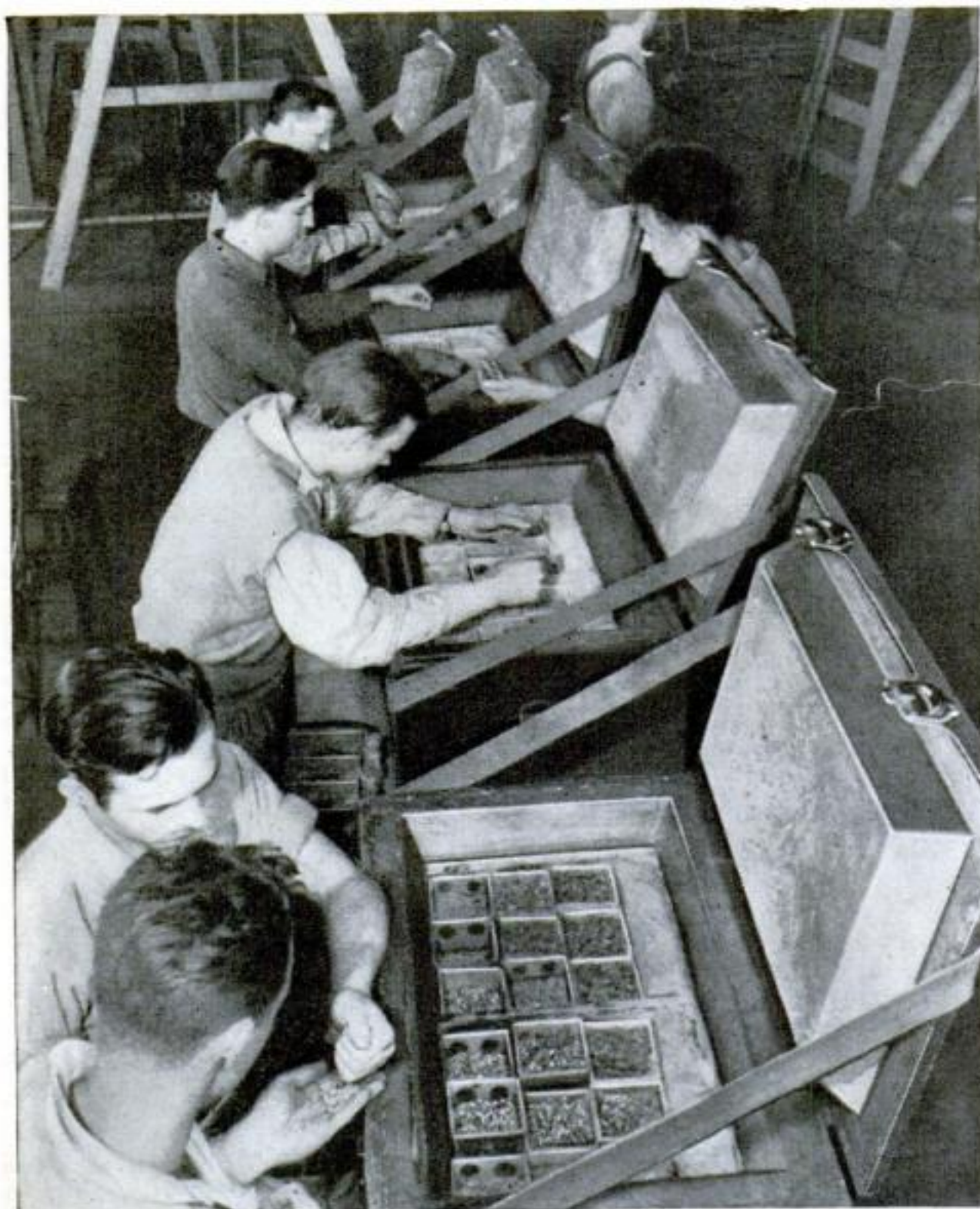
USING trucks of new design, motorized mosquito fighters now help rid Suffolk County, N. Y., of the insect pests. One type of vehicle allows an operator to unlimber a long-handled spray gun, for applying liquid to stagnant pools of water in street drains, without leaving his seat. When not in use, the gun is carried in a handy rack at the side of the machine. A larger



Mosquito crew spraying a pond. At left, a driver treats a street drain



truck carries a crew for more extensive spraying operations afield, in a determined campaign to make the marshy tracts of outlying Long Island uninhabitable as breeding grounds for mosquitoes, and so render it more habitable for humans during the summer season.



Workers removing rivets from dry-ice boxes for immediate use in planes

Refrigerators Keep Airplane Rivets Fresh

RIVETS for use in building giant four-engine bombing planes, seventy-four-passenger Clipper ships, and thirty-three-passenger high-altitude transport planes are stored in special refrigerator cabinets in a Seattle, Wash., airplane factory. Made of aluminum alloy, the rivets are first subjected to a heat treatment in a special unit built for the purpose, and then transferred to storage chambers maintained at a low temperature by solidified carbon dioxide, or dry ice. The cold treatment is said to retard the aging or hardening of the rivets and thus keeps them indefinitely in the proper condition for driving. Rivets are taken from the cold chambers only as needed, and are driven into place within fifteen minutes.

Star Charts Make Midget Planetarium

WITH scissors, glue, and a needle or ice pick, amateur astronomers can transform flat printed charts of the heavens, in a novel book just published, into rounded domes that serve as a miniature planetarium. When a dome is held against a light, holes punched as marked on it show the positions of the stars.



A chart torn from the book forms a dome



Holes punched in the star map show positions of constellations and stars when the dome is held up between the user and a light

Toy Balloons Help Opera Singer Get More Lung Power

DEVELOPING the lung power required to throw an aria into the back rows of the top gallery is a problem that Hilda Burke, New York opera singer, solves by the curious expedient of blowing up toy balloons. As part of her practice sessions, supplementing lessons in voice training, Miss Burke inflates half a dozen or more balloons every day. Balloon blowing, she believes, not only does a great deal to strengthen her lungs, but also tends to enrich her vocal tones. At the right, she is seen engaged in the novel exercise.



Hilda Burke giving her lungs a work-out by blowing up balloons



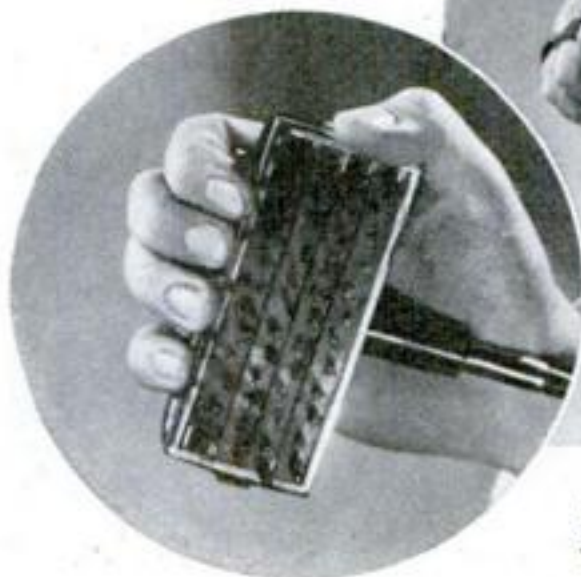
Memorandums put under the flap are always visible

Transparent Writing Flap Tops Off New Desk Cover

MADE in two sizes, for office or home use, a new desk cover is equipped with a top flap made of fireproof transparent material that provides a smooth writing surface. Being hinged, the flap may be raised to permit use of the blotter beneath. Calendars, memorandums, and other reference material can be placed underneath the flap.

Vibrating Brush Provides Efficient Scalp Massage

DESIGNED to massage and brush the scalp to stimulate natural hair growth, an electrically powered scalp brush now on the market vibrates at the rate of 5,000 times a minute. Made in models for both professional and home use, the brush is said to perform in three minutes a brushing that would take fifteen or twenty minutes if done by hand. The brushes are driven by means of a flexible shaft connecting the brush head with an electric motor. Opening two clamps on the side of the brush head allows the user to remove the brush for cleaning and sterilization. Monthly oiling is the only maintenance the outfit requires.



Mechanical scalp brush in use. Its bristles, at left, move 5,000 times a minute



New massage device in use. Paper paddles slap the skin gently

Paddles Provide Cool Massage

WHIRLED by a flexible drive shaft connected to an electric motor, paper paddles in a new beauty device massage the skin. According to the inventor, the paddles create a circulation of air around the area being massaged, thus overcoming the objection of heat created by the massaging action. The device is intended for use by operators in beauty parlors and barber shops.

Standard Musical Pitch Broadcast

MUSICIANS who wish to check the tuning of their instruments can now do so by tuning in on WWV, the radio station of the National Bureau of Standards at Beltsville, Md. The standard for musical pitch, 440 cycles a second for A above middle C, is broadcast twenty-four hours a day, except when other Bureau programs are on the air.

Adjustable Sun Glasses Regulate Light

SUN GLASSES recently introduced can be adjusted by the wearer to admit more or less light, according to the brightness of the sun and its reflected glare. The sun spectacles utilize special light-polarizing glass (P.S.M., April '36, p. 20). Each eye of the wearer looks out through two special lenses. The lens nearest the eye is stationary, while the front lens can be rotated by pushing a small button on the bridge of the spectacle frame. When the button is moved to the extreme left, the maximum amount of light reaches the eyes, but as it is pushed back toward the right, light penetrating the lenses is cut down until they are so dark that the brightest possible beach scene may be viewed without discomfort. Special louvered plastic side shields block out annoying reflections.



By rotating the outer lenses of these sun glasses, a user can admit any amount of light desired, as pictured at the left





Gold Plating on Glass Makes Novel Jewelry

GLASS BEADS plated with gold or other metals are now available. The necklace pictured above is made of glass tubing, chopped into beads, strung, and plated by dipping into a special solution. It is said that the plated beads will not tarnish or leave marks on the skin.

Safety Razor for the Feet Trims Corns and Calluses

CORNS and calluses may easily be trimmed with complete safety, it is claimed, by a new type of corn safety razor. Made with a molded plastic handle, the tool is equipped with a surgical-steel blade shaped to fit a metal guard in such a way that only the exact shaving space necessary to pare corns is allowed between the blade and its guard. Blades are easily changed whenever needed.

Inserting the blade in the corn safety razor, which is seen in actual use below

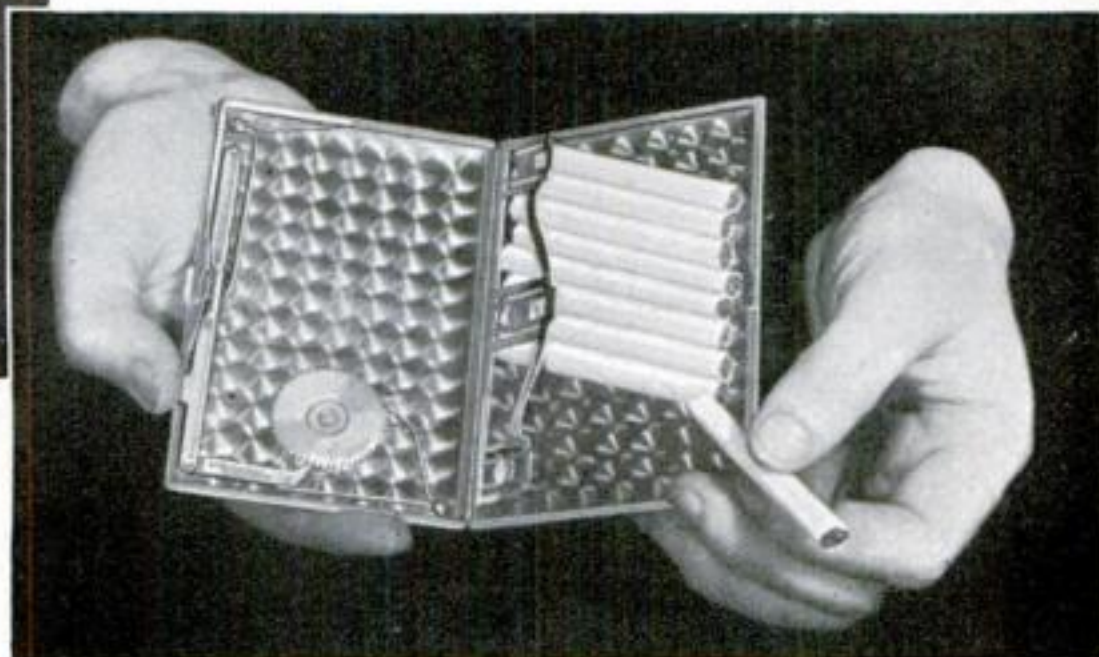


Cigarette Case Keeps Account of Smokes Given to Friends

A NOVEL cigarette case keeps tabs on the cigarettes your friends "borrow." When you want a smoke yourself, press one button to open the case. But when an acquaintance "bums" a cigarette, press a second button. This not only opens the case but operates a counter built into the case.



When somebody cadges a smoke, press a special button to open the case. A counter registers the gift, keeping track of those given away

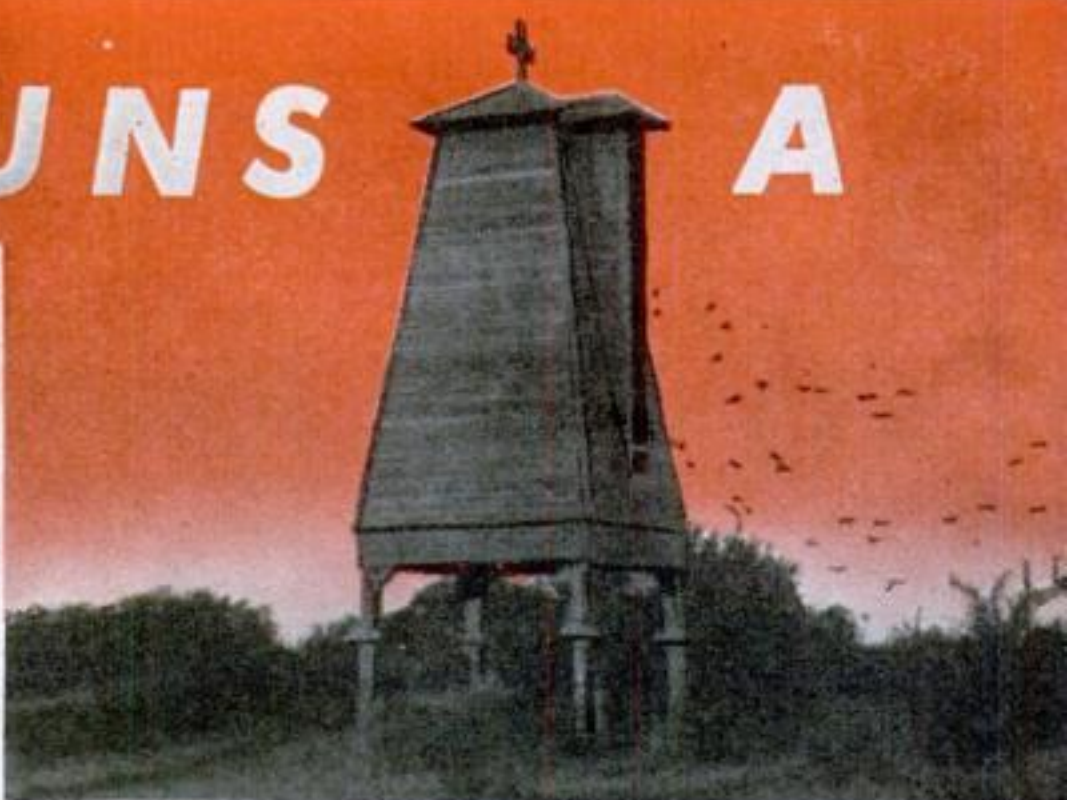


HE RUNS A



Thousands of bats in the roost maintained by Milton F. Campbell, of San Antonio, Tex., seen at right preparing to harvest guano

PLAYING host to 250,000 bats is the queer but profitable hobby of Milton F. Campbell, of San Antonio, Tex. His lakeside bat hotel, a tall wooden tower shaped like the base of a windmill, is the outgrowth of experiments begun years ago by his father, Dr. Charles A. R. Campbell, at that time city bacteriologist of San Antonio. Believing that bats would rid the area of malaria-carrying mosquitoes, Dr. Campbell spent years trying to induce the creatures to settle in a wooden roost which he constructed near the city sewage plant. Finally, by means of ear-splitting phonograph records, which drove the bats



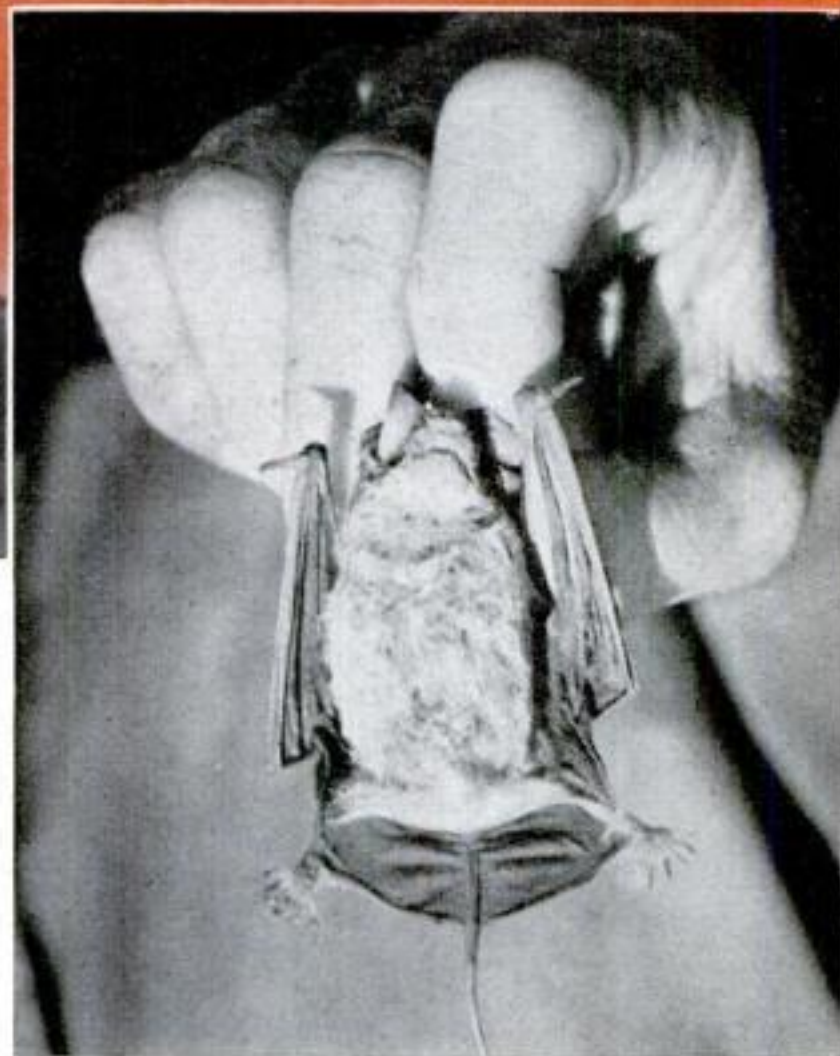
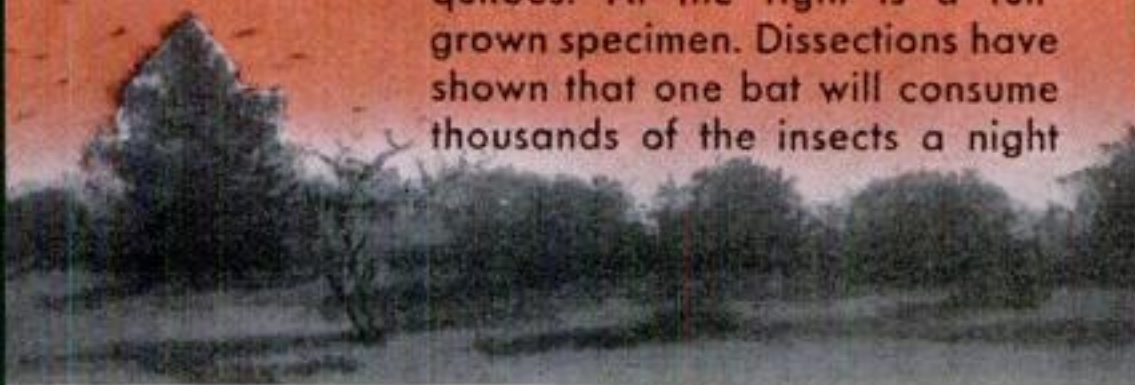
from their accustomed haunts, he effected their transfer to his specially constructed tower.

Soon afterwards, residents of the region began to notice a decrease in the number of mosquitoes. A single bat, Dr. Campbell discovered by dissection studies, will consume as many as 3,750 of these pests during a



HOTEL FOR BATS

At dusk, bats swarm out in clouds to feed on disease-bearing mosquitoes. At the right is a full-grown specimen. Dissections have shown that one bat will consume thousands of the insects a night



single night's feeding. Since its introduction, the Campbell bat roost has been a source of revenue as well as a laboratory for the study of the strange little creatures it houses. Visiting bats, tens of thousands of them that choke the interior and often hang in great bunches from the outside eaves, pay their rent by adding to the accumulation of guano in the roost.

Once a year, Campbell cleans this deposit from the interior, raking it down a chute at the bottom and sacking it up for sale. Bat guano is said to be a nearly perfect fertilizer. Sampled and labeled, as required by law, it sells for from five to ten cents a pound. Last year, the roost yielded nearly 6,000 pounds of guano. In fact, so profitable has the

unique venture become that quantities of the special lure used for attracting bats, and detailed plans for establishing similar roosts, have been sold to prospective bat raisers in several parts of the country, with an eye to both profit and mosquito control.



Karl Busch with some of the products of his novel pastime

Artist Makes Faces of Avocado Seeds as Lapel Ornaments

PROBABLY the only avocado-seed carver in the world is Karl Busch, a Hollywood movie-studio artist whose hobby is turning the seeds into odd little faces to be used as lapel ornaments. Already, Busch has produced more than seventy-five of the oddities. Originally, the seeds are soft and easily worked. After the carving is completed, Busch places them in the sun for curing. When they are almost as hard as ivory, he paints them with bright-hued water colors and applies five coats of lacquer which give a high gloss and preserve the material almost indefinitely against rot.

Tiny Museum Holds 25,000 Rare Items

FORTY years ago, Frank S. Van Den Bergh, a retired estate superintendent of Santa Barbara, Calif., sent a shell he had picked up to a physician in Japan. In return, he received a shell from the Orient. That was the beginning of a remarkable one-room museum holding 25,000 specimens, most of them acquired by trading.

Excepting for short trips, Van Den Bergh has never traveled in quest of specimens. By correspondence, he has assembled, from eleven different countries, the 15,000 shells and the 10,000 miscellaneous items which cover the walls and ceiling of his twelve-by-twenty-foot museum.



Frank S. Van Den Bergh shows a skull of a prehistoric Indian unearthed near his Santa Barbara, Calif., home

Besides 7,000 arrowheads, he has ancient skulls from the Southwest and a rare Indian boomerang used by an early American

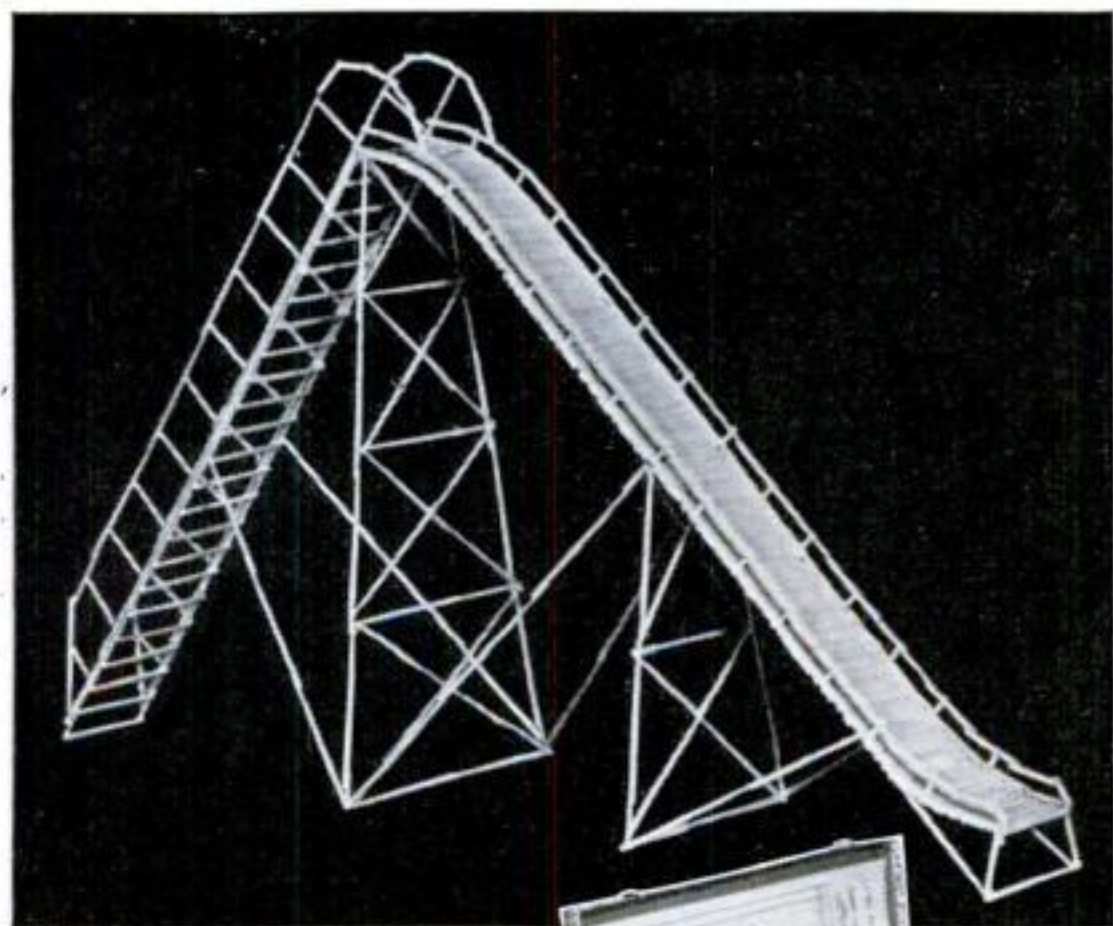
hunter centuries before the coming of the white man. One unusual contribution from the Orient is a miniature reproduction of India's famous temple, Taj Mahal. It arrived smashed and had to be carefully repaired.

Among the vast collection of shells in his Tom Thumb museum, Van Den Bergh has specimens hardly larger than sand grains and others so big they once housed Australian clams that weighed 100 pounds. How much his complete collection is worth, he can only guess. One shell alone, a rare *Voluta* from Florida, would bring \$200. Recently, Van Den Bergh parted with seven shells for twenty-five dollars—the first cash sale he has made since starting his museum.

By trading with other collectors in two hemispheres, the hobbyist turned this small room into a private museum with 25,000 rare items



Toothpick Engineers Get Building Kit

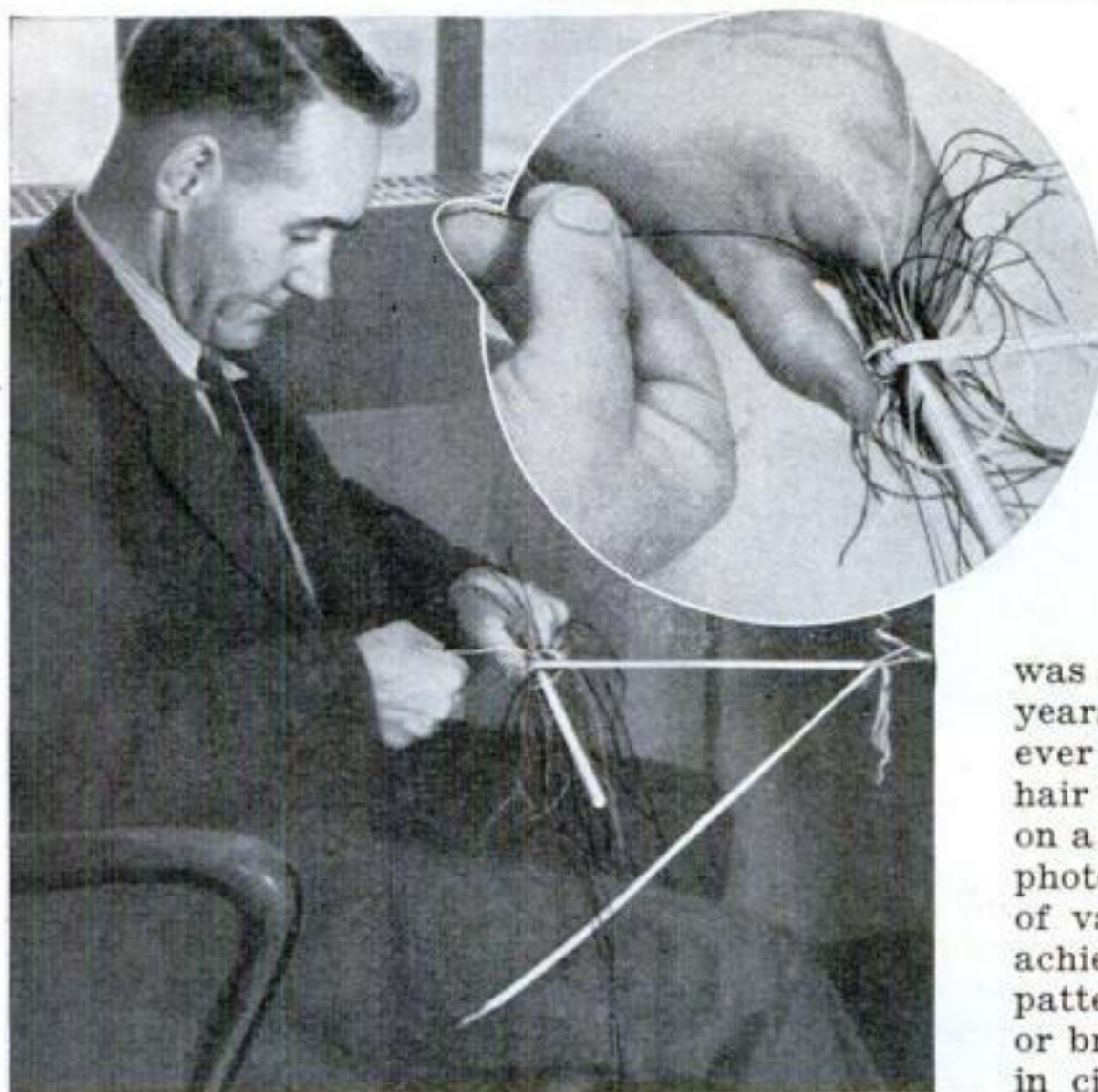


This model playground slide was built with tools and materials contained in the kit

As illustrated at the right, the outfit comes packed in a handy case with a carrying handle



FOR those interested in the hobby of constructing models with toothpicks and glue (P.S.M., Feb. '40, p. 70), a New York manufacturer has just introduced a special kit. In addition to a supply of toothpicks and cement, the kit has a pair of cutting pliers and a pair of small tweezers. The outfit, made in two sizes, is packed in an attractive box that is fitted with leather handles and metal locks to resemble a suitcase.



Eugene Barnett engaged in his unusual hobby. The horsehair is woven on a round dowel rod, as shown in circle

Hobbyist Revives Old Indian Art of Weaving Horsehair

MAKING belts, bridles, harness, whips, and other articles of horsehair is the unusual hobby that Eugene Barnett, of Grangeville, Idaho, has turned into a paying business. The art of weaving horsehair, once practiced by the Indians, was revived by Barnett some thirty years ago, and he has been doing it ever since. Black horsehair, as well as hair dyed in various colors, is woven on a round dowel rod, as shown in the photographs at the left. Horsehairs of various colors make it possible to achieve interesting and decorative patterns in the finished work. A belt or bridle, woven on the rod, comes off in circular shape when finished, and is then pressed out flat. Barnett gets unusually high prices for his work.

Composer Collects Music Boxes

COLLECTING old and rare music boxes is the interesting hobby of Paul Taubman, New York pianist and composer. His collection, rated among the finest privately owned in the world, includes such rare items

as the music box that combines a harmonium and a bird organ, an instrument that emits bird trills and was once used to teach canary birds to sing. Another is a masterpiece of ingenuity. Driven by a spring motor, it plays eight different tunes and can be set to repeat any selection or play the tunes in any desired sequence. The instrument also boasts a volume adjuster, bass and treble tone control, and a speed regulator. Taubman picked it up for twenty-five dollars, and values it now at nearly \$10,000. Interest in these musical machines, which often combine several instruments in one, led Taubman to master the art of playing a piano and an organ at the same time, as pictured at the left.



Music boxes led Paul Taubman to learn to play piano and organ simultaneously

This ingenious Swiss machine plays eight different tunes in any order desired. The hobbyist is seen at the right with part of his collection. He holds in his hands a musical jewel box



Fast Patrol Boat Mounts Heavy Armament



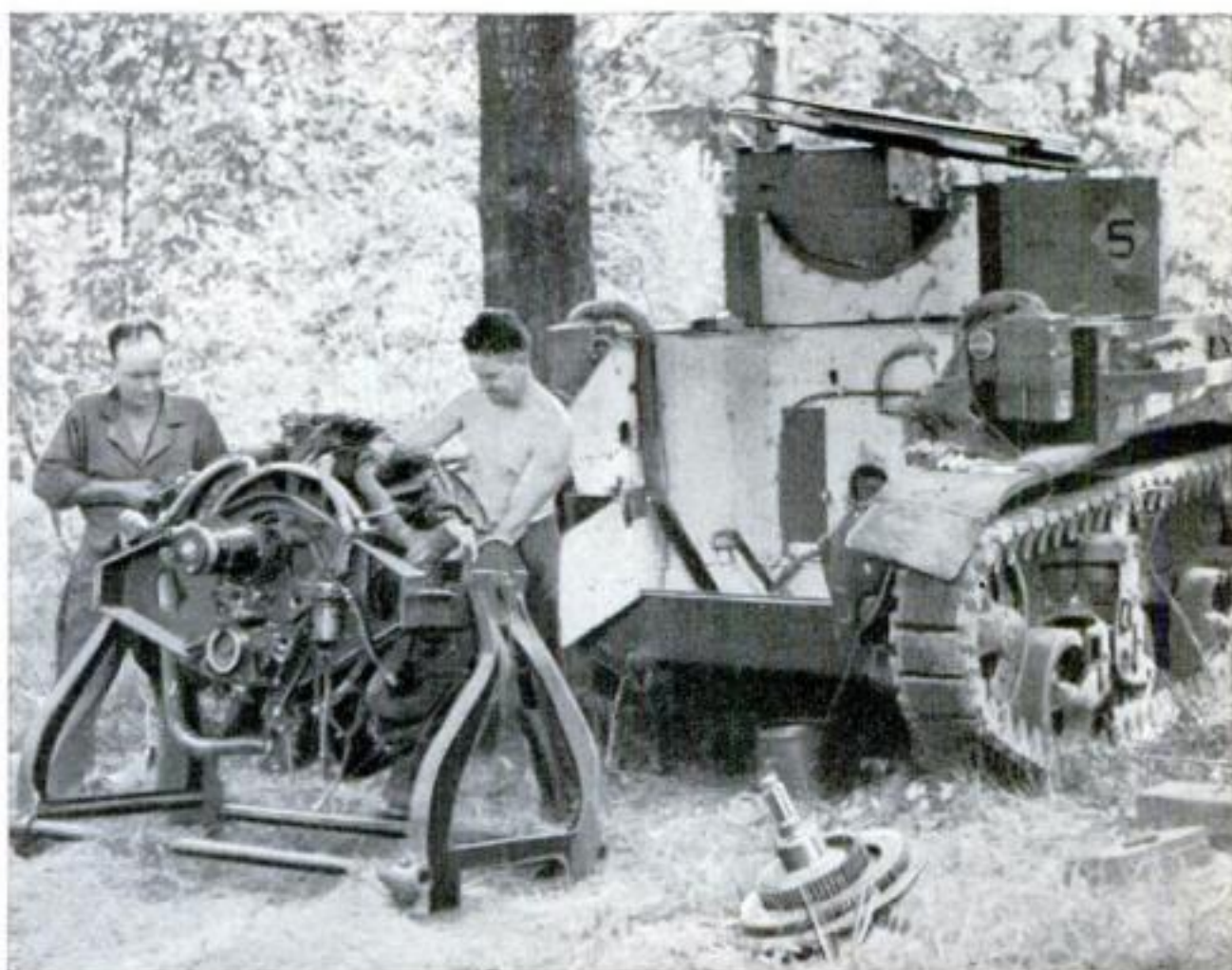
One of Uncle Sam's experimental mosquito fleet, designed to guard important coastal waters in wartime

SMALLEST of the U. S. Navy's fighting craft, the fifty-nine-foot coastal motor boat *PT3* carries formidable armament into action at racing speed. With thirty similar boats ranging up to eighty-one-foot length, built or building, it will form an experimental mosquito fleet armed with torpedoes, depth charges, machine guns, and smoke-screen generators. The boats can be turned

out rapidly by mass production. A potent threat to submarines and surface warships alike, they are intended mainly for patrolling such waters as Chesapeake Bay, Puget Sound, and the mouth of the Mississippi River. By taking over these duties, they would release destroyers for operations far at sea. The name, *PT3*, is the Navy's designation for "patrol torpedo boat No. 3."

Tank Engines Are Repaired in the Field

ENGINES of radial design, like those of airplanes, propel military tanks of the U. S. Army. Quickly demountable for repairs, the motors are easy to overhaul in the field, as shown at the right. The scene took place at recent maneuvers of the U. S. Army Tank Corps in Louisiana. Shortly after the picture was made, the speedy mechanized unit was rolling on its way.



Tank Corps mechanics overhauling a radial motor in recent Army maneuvers

Can We Defend Our Coasts?

By
ARTHUR GRAHAME

A twelve-inch mortar
lets fly at a target



A GLIMPSE OF A LITTLE-KNOWN BUT VITAL LINK IN NATIONAL DEFENSE—THE COAST ARTILLERY

MOST people think of the Navy as our first line of defense. In one way it is, and in another way it isn't. Its major war job would take it on an offensive mission—to head off and defeat an approaching enemy fleet, far from our home shores. Stringing out the big-gunned ships for close-in defense of our long ocean frontier would make their offensive use impossible, would abandon the seas to the adversary, and would surrender our overseas possessions and our maritime routes for obtaining vital war supplies. Our widely scattered warships would be push-overs for a concentrated hostile fleet. Therefore our "ships of the line" must be kept together, regardless even of the off chance that fleets in the Atlantic and Pacific might attack us simultaneously.

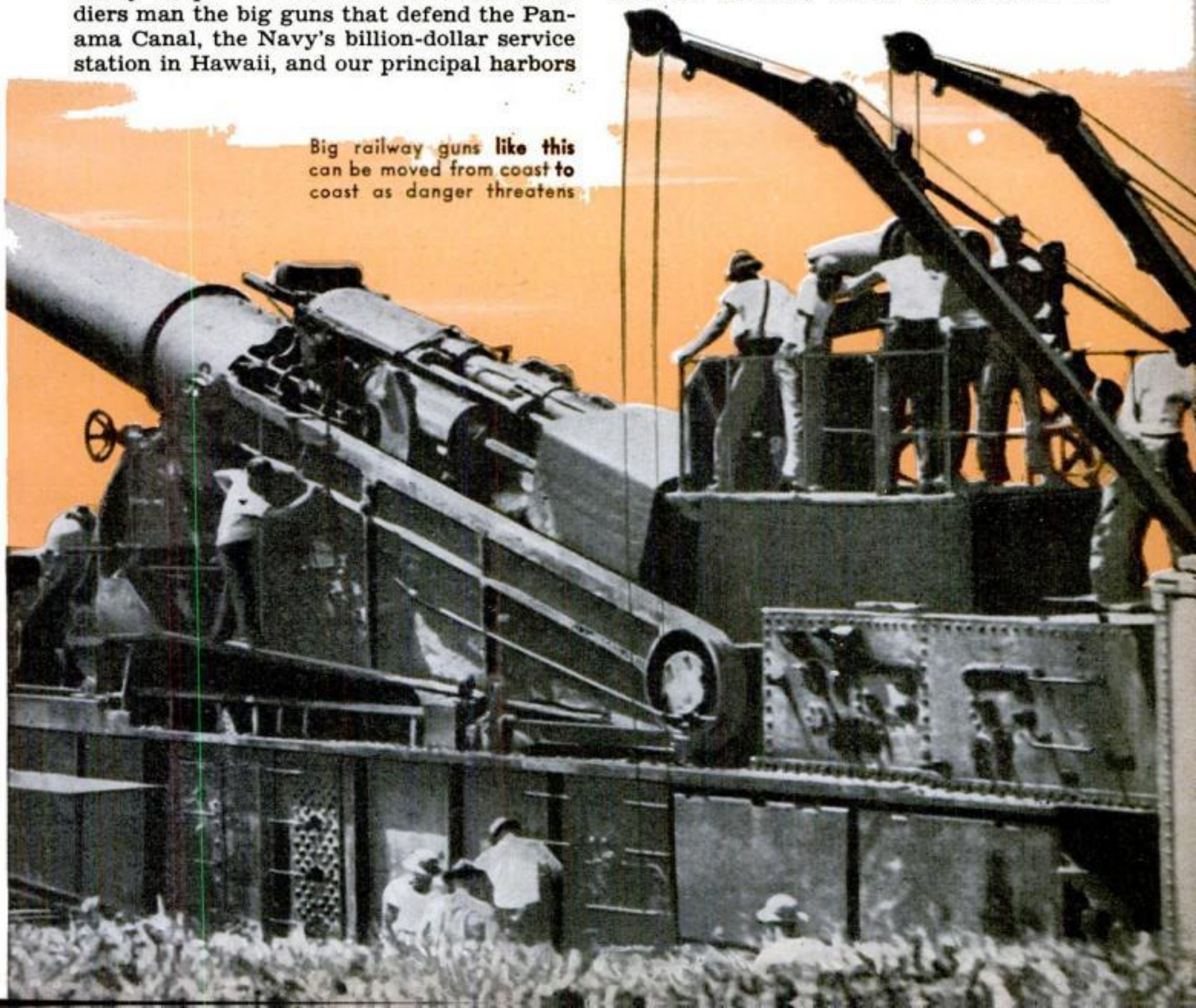
So if the word defense is used in its narrower, close-to-home sense, the U. S. Navy isn't a defensive weapon at all. Our first line of defense becomes the Army's Coast Artillery Corps. Its seldom-written-about soldiers man the big guns that defend the Panama Canal, the Navy's billion-dollar service station in Hawaii, and our principal harbors

and seaport cities located on the mainland.

There aren't, and there never will be, enough guns in America to cover all our many thousands of miles of seacoast. Fortunately, that sort of defense isn't necessary. To have any real chance of success, a modern invading army must control well-equipped ports of disembarkation. Soldiers sometimes can be landed on an open beach, but it is next door to impossible to land tanks, large-caliber field guns, and all the other heavy material which is essential to present-day mechanized warfare without adequate facilities. So the chief wartime responsibility of the Coast Artillery would be the protection of the United States against invasion by keeping our important seaports safe against capture.

Other of its numerous duties would be guarding our thickly populated coast cities against bombardment by enemy warships, protecting the Navy's bases, and defending the fortified strong points in our system of seacoast defense, which would allow our

Big railway guns like this
can be moved from coast to
coast as danger threatens



mobile ground Army and Air Force to remain concentrated for quick action against an invader who took the long chance of landing on some unprotected beach. To both the Navy and the Army the harbor-defense artillery is as invaluable as a good goalie is to a hockey team, and for the same reason—by playing Kitty-bar-the-gate it gives the rest of the team freedom to attack.

To do their work of protecting us against invasion or bombardment from the sea, our harbor-defense troops have two potent

weapons—big guns and submarine mines.

The king-pins of their armament are the mighty sixteen-inch guns—as large seacoast guns as there are in the world except for a few eighteen-inchers which the British have mounted in their Singapore defenses. They have an extreme range of twenty-eight miles—the range of a sixteen-inch gun mounted in a battleship turret is about twenty miles—and at somewhat shorter ranges their one-ton nickel-chrome armor-piercing projectiles will perforate even the thick and tough face-hardened armor which protects the sides and turrets of a battle-

One of the fixed sixteen-inch rifles that protect vital points. It hurls its one-ton projectile twenty-eight miles



Crew members brace themselves as a six-inch disappearing gun loses its thunder



ship, and burst in the ship's vitals with effects likely to be deadly. Operated by electrical machinery, they can be fired for indefinite periods at an astoundingly high rate of speed. It is these mighty weapons which are most depended on to keep any hostile fleet well out of range of the vitally important locks of the Panama Canal, the naval base at Pearl Harbor in Hawaii, and cities such as New York and San Francisco.

Disappearing guns, in which the recoil throws the gun back to loading position behind a parapet and counterweights bring it back into firing position, aren't being built

these days because the design of their carriages makes it impossible to give them sufficient elevation for long-range fire. But we have a good many of them in our coast defenses, and their 1,560-pound projectiles have what it takes to sink a battleship—if the battleship obligingly comes within their range of ten miles. Another of our coast-defense weapons whose game is the capital ship is the twelve-inch gun, with a range of seventeen miles. The high-angle plunging fire of the twelve-inch mortars mounted in many of our coast defenses is dangerous against the

deck armor of any ship which ventures within their eight-mile range. Batteries of ten-inch and six-inch guns, which have ranges of about eight miles, are for use against cruisers, destroyers, transports, and other non-capital ships. A hit in a vital spot by a six-inch gun will put a destroyer out of action. Three-inch rapid-fire guns, which have a range of six miles, are used to protect mine fields.

All our fixed seacoast guns are mounted in harbor defenses, but not all of them are protected by concrete parapets or bombproof emplacements. Against the growing menace of the bombing airplane, concealment is considered even more important than protection, and some of our newest big guns are mounted in the open and depend on clever camouflage for comparative safety. Antiaircraft guns, both fixed and mobile, are provided for the protection of the big guns and the men who fight them from attack from the air.

Railway artillery is equally valuable for supporting fixed guns in the defense of fortified positions and for use against an invader attempting a landing at a place not protected by permanent coast defense but within a reasonable distance of a railroad line. Fourteen-inch railway guns have a range of twenty-four miles; their job is to attack an invader's battleships and big cruisers. Eight-inch railway guns have a range of thirteen miles, and are for use against lighter warships and transports. Railway artillery has the important advantage of what the soldiers call "strategical mobility"—although it can't be moved very fast, it *can* be moved from one coast to the other.

Regiments of 155-millimeter tractor-drawn guns—the same type of heavy gun that is used by our Field Artillery—also are part of our coast-defense system. They are capable of fairly high road speeds, and they do not require previously prepared positions. Their range is about ten miles.

Both railway and tractor guns are highly important weapons in the defense systems of the Panama Canal and Hawaii.

Much less spectacular than the Coast Artillery's big guns, but every bit as important for the defense of our harbors, are its fields of submarine mines. Mine fields are carefully planned in peacetime, the mines and (Continued on page 218)



The men behind the guns: Coast Artillerymen loading a railway mortar at target practice



Coast Guard Patrols Sea Lanes

TO KEEP an eye on all vessels approaching our northeastern coast, two-mile-a-minute flying boats from the U. S. Coast Guard station at Floyd Bennett Field, New York City, are combing the sea lanes in swift patrols. The flights carry them over an ocean beat that extends from Rhode Island to Maryland. Taking off in 1,700-horsepower Hall biplane flying boats that have a range of well over 1,000 miles, or in twin-motored Grumman ships that cruise at 125 miles an hour, the pilots and observers often head far out from shore. Whenever a vessel is sighted, the winged ship swoops down and circles until identification is complete. Should there be anything suspicious about the craft, a report is flashed by radio to shore headquarters. From other Coast Guard bases on the Eastern seaboard and on

the Gulf of Mexico, similar patrols are also being carried on. At present, more than thirty long-range Coast Guard flying boats like that shown in the illustrations on this page, are engaged in the work.



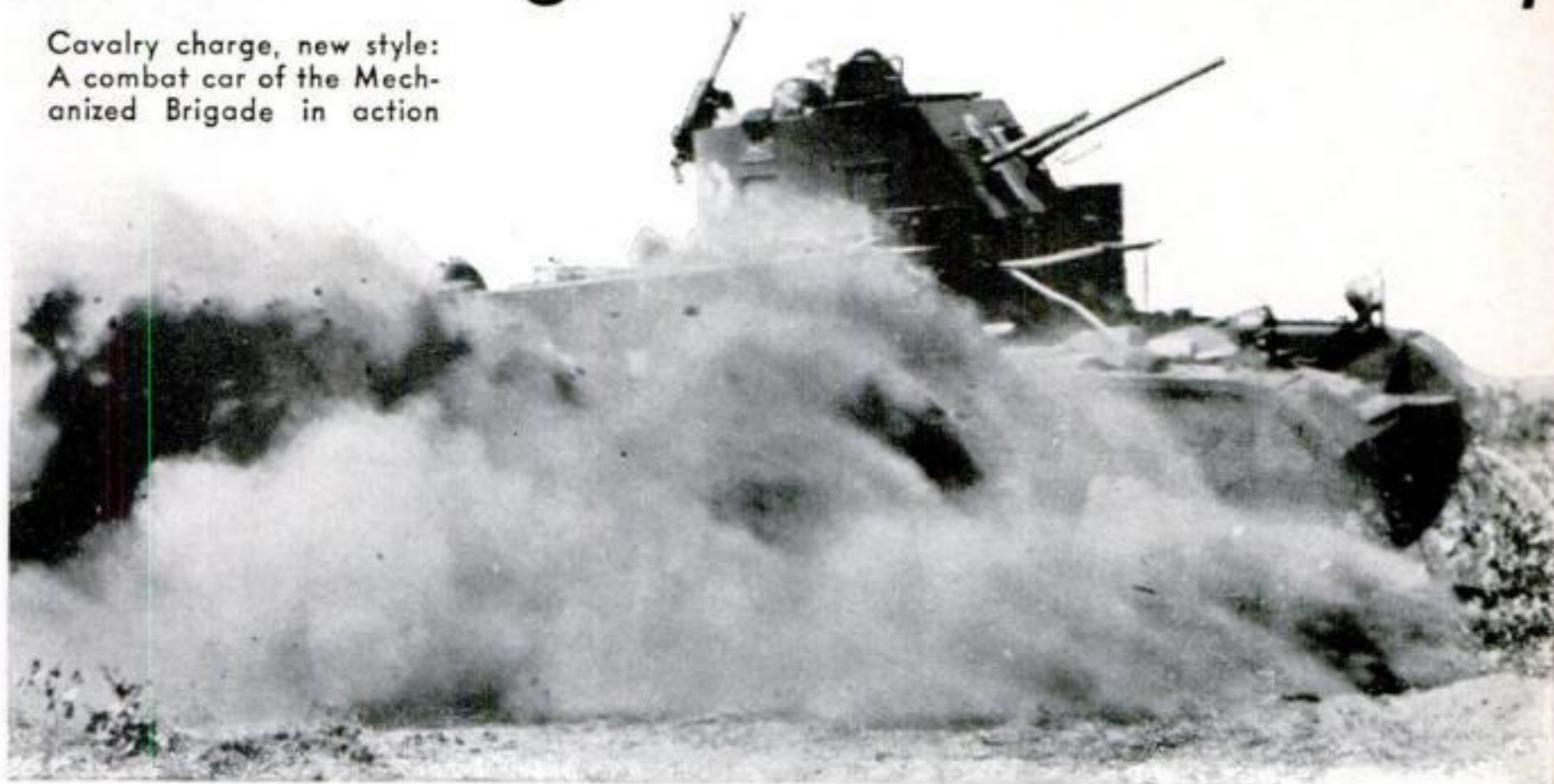
The pilot hands his radio operator a message for headquarters, reporting a suspicious vessel



Flying boat circling a ship for identification. Map is a report showing vessels sighted on patrol

Grooming the Iron Cavalry

Cavalry charge, new style:
A combat car of the Mechanized Brigade in action



By **ARTHUR A. STUART**

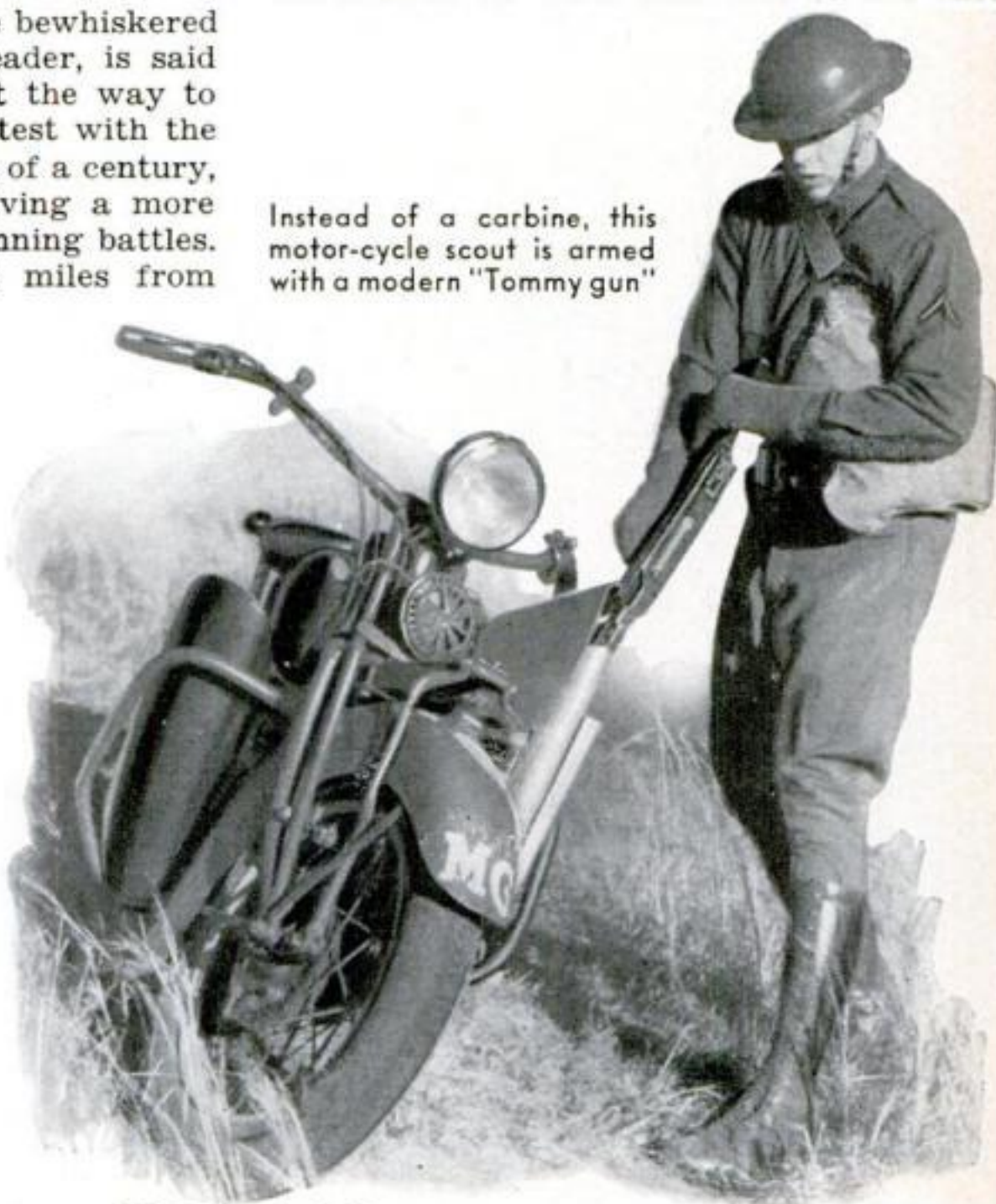
OLD Bedford Forrest, the bewhiskered Confederate cavalry leader, is said to have remarked that the way to win in war is to "git thar fustest with the mostest." After three quarters of a century, no one has succeeded in evolving a more generally useful receipt for winning battles.

At Fort Knox, twenty-odd miles from Louisville, Ky., is stationed the Army's most modern implement for "gitting thar fustest with the mostest"—the fast-moving and hard-hitting mechanized force which is designated officially the Seventh Cavalry Brigade (Mechanized), but which the Army prefers to call "the iron cavalry."

In this supermodern cavalry the armored fighting vehicle has taken the place of the horse, commands snap out of radio receivers instead of ringing from brazen trumpets, the staccato machine gun has superseded the gleaming saber, and the monkey wrench has taken the place of the pitchfork. But in spite of all these changes and innovations, the

iron cavalry still is cavalry. The troopers talk about engines and transmission systems instead of about horses and saddles, but they are trained to think fast and to act fast

Instead of a carbine, this motor-cycle scout is armed with a modern "Tommy gun"



and boldly, and so to carry on the great tradition of American cavalry.

The iron cavalry has the true cavalry spirit, and it is armed, equipped, and trained to do the traditional work of cavalry in war—to carry out distant scouting missions, to seize critical positions and hold them until the infantry has time to come up, to guard the army's flanks, to attack the enemy's flanks and go swinging around them to raid his communications and destroy his supply depots, to pursue a beaten enemy. When conditions of ground and weather are favorable for its use, the Mechanized Brigade is best suited to do many of these things, because it can go farther faster, and hit harder when it gets there, than can horse cavalry.

The Mechanized Brigade consists of a brigade headquarters troop, two fully mech-

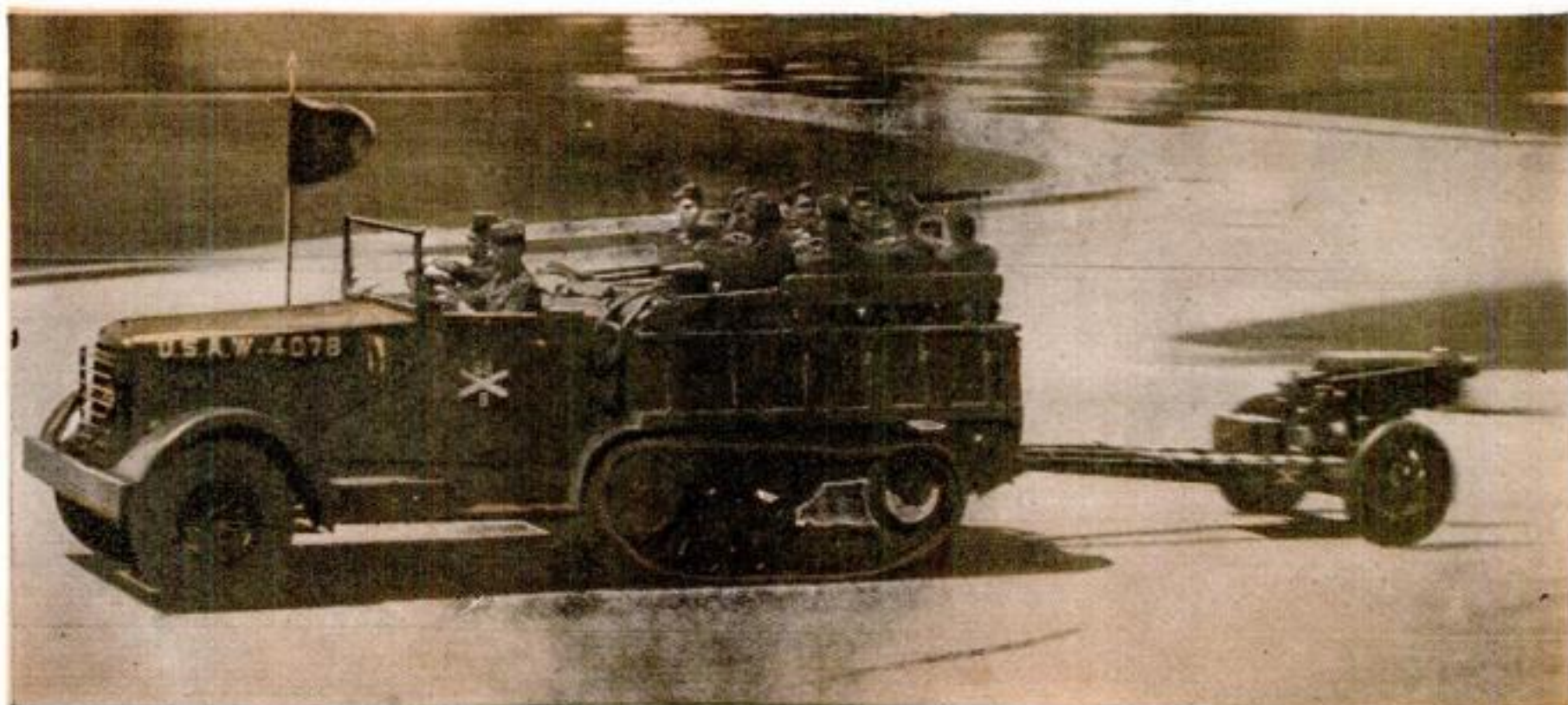
anized regiments of cavalry, a battalion of field artillery which has four motor-drawn firing batteries each of four 75-millimeter howitzers, an ordnance maintenance company for the fighting vehicles and a quartermaster maintenance company for the trucks and other vehicles, a signal detachment for radio communication, a medical troop, and a squadron of observation aviation. Its present authorized strength is about 2,000 men, but it is hoped to double its strength both in men and fighting vehicles.

THE backbone of the mechanized force's fighting power is its armada of 112 combat cars—two two-troop squadrons of them in each of the cavalry regiments.

Cavalry combat cars are light tanks with full track-laying mechanism. They have the same engineering features which make our infantry light tanks the world's best—airplane-type, air-cooled engines which are more powerful than the engines of any other country's light tanks (see page 93), dependable transmission

Machine gunners "dismount" from a half-track personnel carrier. Below, observation-squadron planes in flight over a line of combat cars





"Bringing up the guns." The gun crew rides in the same vehicle that tows the 75-millimeter howitzer

and drive, and long-wearing tracks of rubber composition set in steel blocks which have proved that they can stand up under even the intense heat generated by the friction of long, fast marches over sun-baked southern hill roads. A few of the combat cars have Diesel engines.

Weighing nine and a half tons, the combat cars—the troopers call them "hell buggies"—are a couple of tons lighter than the infantry light tanks, and they are faster and more maneuverable. Their top road speed is better than fifty-five miles an hour, and they can "cruise" at forty-five miles for long stretches without unendurable strain on either machines or crews. Cross-country, their top speed is considerably in excess of twenty miles an hour over average ground, and their obstacle climbing is spectacular. Because of their lighter weight, their armor isn't so thick as that of the infantry tanks. The iron cavalry is willing to sacrifice some degree of protection to get more speed.

Another feature in which the combat car differs from the infantry tank is that it has one turret instead of two, and that its guns may fire in any direction. The crew consists of four men, and the armament of one .50 caliber and three .30 caliber machine guns—one of the latter in an anti-aircraft mount. Each car also carries a Thompson submachine gun for close-quarters fighting, and each crew man is armed with a .45 caliber automatic pistol. This heavy armament gives the combat cars tremendous fire power. They also may be used as shock weapons. They won't be wasted in an attack on an enemy's carefully prepared main position, but when the right opportunity for their use arrives their thundering, lurching advance in fire-spitting waves will be the machine-age version of the boot-to-boot charge of yelling, saber-brandishing troopers.

In addition to its two squadrons of combat cars, each of the mechanized cavalry regiments has a reconnaissance troop and a machine-gun troop.

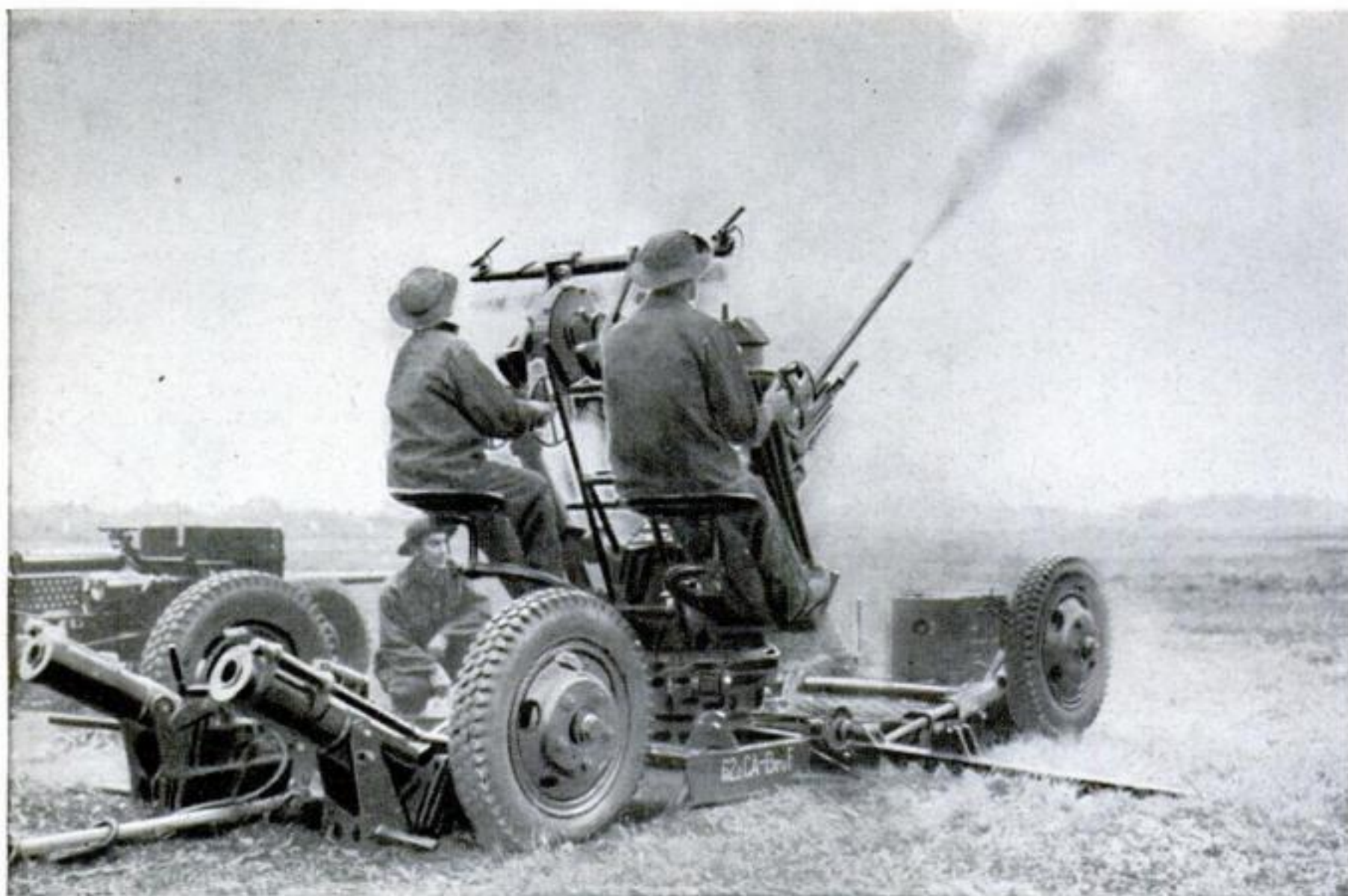
The job of the reconnaissance troop is scouting—especially long-distance scouting. One of the regiments is equipped with scout cars for this purpose, and the other with armored cars. The scout car is a fast, four-wheel drive vehicle with high sides of light armor. It carries a crew of from six to eight, and its armament consists of three machine guns mounted on a rail running entirely around the car's top, giving the gunners an all-around field of fire. The armored car is a six-wheel, rear-drive vehicle closed in over the top by a turret.

The business of the machine-gun troop is to cover the advance of the combat cars with their fire, and to give the iron cavalry increased defensive power when it is necessary for it to hold a position against an attack. The machine gunners do most of their fighting on the ground, but they ride to the scene of action—the troop of one regiment in scout cars, and the troop of the other in half-track personnel carriers. The latter are light trucks with the rear wheels replaced by a track-laying mechanism.

ANOTHER distinctive type of combat vehicle used by the Mechanized Brigade is the mortar mount, a specially built four-wheel armored truck carrying a smoke mortar which its crew can dismount and set up to lay down a smoke screen to cover the advance or withdrawal of the brigade.

Motor cycles are used for various purposes, their riders being armed with rifles or with the submachine guns which the troopers call "Tommy guns."

To keep up with an outfit which can move as fast and as far (*Continued on page 222*)



U.S. Army Gets a New Antiaircraft Gun

SAID to be effective against low-flying bombers as well as hedge-hopping attack planes, the antiaircraft gun pictured in action in the photograph above is one of the U.S. Army's newest weapons for defense against possible enemy air attacks. Capable

of being towed from one position to another at high speed, the thirty-seven-millimeter gun fires at the rate of 125 shells a minute. Each projectile weighs one and a third pounds.



Rear view of the torpedo mine. Sound waves guide it to its prey

Electric Ears Aim Odd Torpedo Mine at Enemy Vessel

HUNTING its prey with electric ears, another version of the sonic torpedo (P.S.M., Mar. '40, p. 78) combines features of a mine and a torpedo. Four feet long and weighing 150 pounds, the torpedo-shape unit has twin propellers and a rudder. In use, the weapon is anchored under water. By means of an electrical mechanism, the noise created by the propellers of an approaching ship causes the mine to release its anchor and starts its propellers whirling. Guided by the sound waves set up by the ship, the torpedo-mine steers straight at its objective, exploding on contact.

Model Shows Tooth Formation



Dr. Moses Diamond with the giant model of an embryo tooth, 100 times natural size. At upper left, the hinged top has been lifted



Tracing projected cross sections (top) and cutting them out of plastic

TO DEMONSTRATE their discovery of the exact manner in which enamel is formed on teeth Dr. Moses Diamond and Joseph P. Weinmann, of the Columbia University School of Dental and Oral Surgery, recently constructed a novel plastic model of an embryo tooth which is exactly 100 times the size of the original. The

original tooth was first dissected by the investigators into microscopic cross sections, which were mounted on glass slides. These were then projected onto tracing paper, enlarged to 100 times their size. These projected images were traced on the paper, which was then laid over sheets of a special plastic material. By gentle hand pressure, the tracings were transferred to the surface of the plastic, and the outline cut out with a knife. Cross sections of the original tooth varied in thickness from two to five microns, or thousandths of a millimeter, so the plastic enlargements were therefore made from 200 to 500 microns thick. When the entire number of cross sections had been completed, they were placed one over the other in the same respective positions as the original tooth sections, thereby producing the tooth model. Two and a half feet long, the tooth model has its upper half hinged to the lower so that interior details may be examined.

How Plant Doctors



A plant doctor's laboratory—citrus trees growing in garbage cans filled with nutrient solution. Serving as test specimens, these trees are inoculated with disease germs to determine their resistance



Boring a hole in a tree to inoculate it with virus, as at right



Protect Our Crops

Tree Diseases Studied Like Human Ailments

MORE than sixty scientists attached to the University of California's Citrus Experiment Station, at Riverside, are concentrating on a battle against the diseases that threaten countless acres of citrus groves, and deciduous fruit and date orchards of the southwestern United States. Were it not for their activity in tracking down mysterious plant infestations, devising preventives and cures through ceaseless laboratory experimentation, and developing disease-resisting varieties, the nation's supply of oranges, lemons, dates, and other fruits might be seriously curtailed, and the loss to fruit growers would run into millions of dollars in a short time.

Gas pumped into the ground with this "hypodermic" prevents spread of fungus to date trees.

An orange tree growing in a 1,300 gallon tank. If it passes tests, it will be employed in crossbreeding

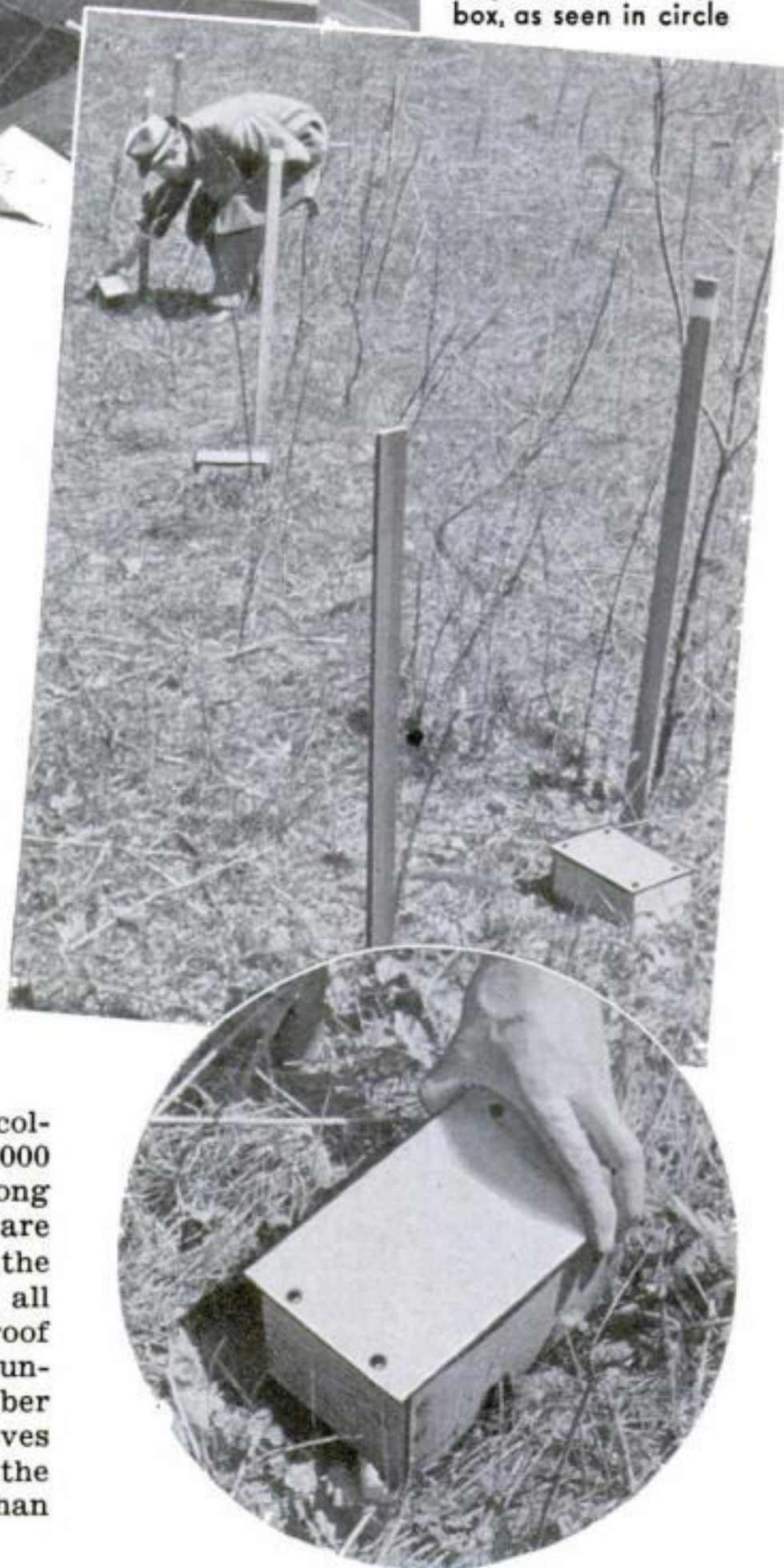


Scientists Run Mouse-Trap Line



One of the mouse trappers examining a trap of the kind used. Beside him is a tray of specimens for study

Below is a section of the line. Stakes mark trap locations. Each trap is set in a runway and covered by a box, as seen in circle



IF A certain number of mice are living on an acre of land one year, there may be six times as many there next year, or there may only be half as many. Why? What causes animal populations to move in cycles? How long or how frequent are the cycles?

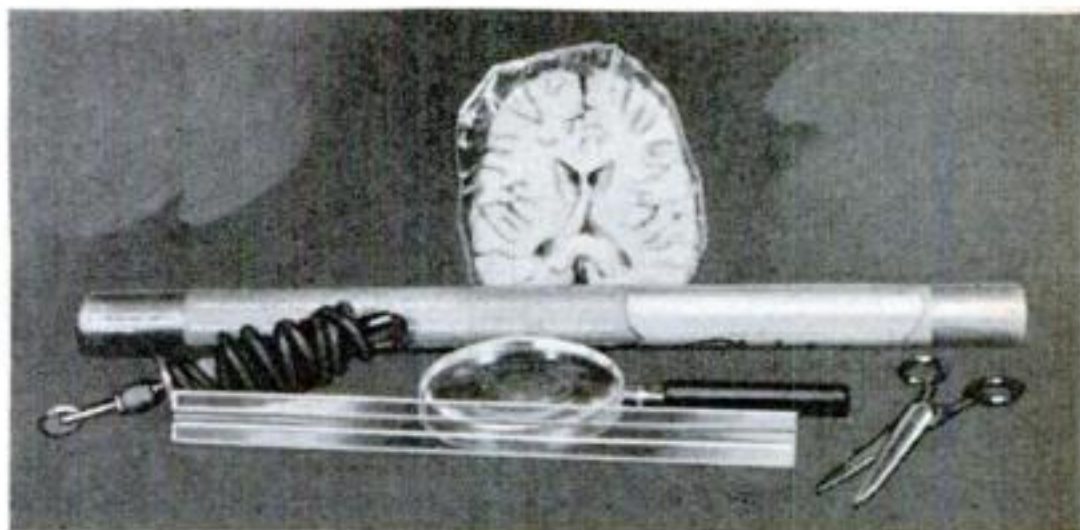
To solve these questions in the riddle of animal-population changes, B. P. Bole, Jr., and Philip N. Moulthrop, of the Cleveland Museum of Natural History have established a trap line they hope to maintain for fifty years. By trapping, every day except Sunday, over that period, the mice inhabiting a circular half acre of ground in Kirtland Hills, Ohio, the scientists hope to assemble mouse-population figures that will unlock the mystery. They may be able to predict the approach of "mouse years," and thus give advance warning against rodent damage. And the traps form a means of building up the museum's mouse collection, which now numbers more than 15,000 preserved mice, and is used to study, among other things, rodent diseases, some of which are suspected of being related to human ills. On the circular trapping area, 100 traps are set at all times, each being covered with a weatherproof box and placed in a hole that cuts into an underground mouse runway. Each day a member of the museum staff visits the scene, removes the catch, and resets the traps. Figured on the fifty-year basis, that means that more than 15,000 visits will be made to the trap line.



Sections of human brain wrapped in transparent film. At the right is the equipment used in preparing them

Rubber Film Preserves Specimens for Medical Demonstrations

ENVELOPES of a transparent rubberized material are being used by a Boston, Mass., neurologist for preserving sections of human brain and other medical specimens employed in lectures and demonstrations. After a month's treatment with a preservative, specimens are placed in the transparent sacs, which are then sealed by heat. In this form, the material is handled and transported easily.



X Rays Spot Decayed Power-Line Poles

WOODEN poles that support electric-light wires are now being X-rayed to determine whether they are sound, or decayed to the point of requiring replacement. A Detroit, Mich., utility company utilizes a portable X-ray unit, inclosed in a cabinet mounted on a small truck, as shown in the photo-

graph. The poles are photographed at their bases, just below the level of the ground, where decay is most prevalent. Boring is the orthodox method of testing the poles for decay, but the X-ray system, in recent tests, is said to have proved more accurate and less wasteful.



Testing a pole for decay. X rays are aimed slanting downward through the wood just below ground level

NEW EXPERIMENTS WITH ROCKETS

PROTECTED against deadly explosions by a wall of sandbags and heavy timbers, two young California Institute of Technology scientists feed explosive gases under pressure into the motor of a rocket. At the touch of a button, a leaping spark ignites the mixture, and with a roar, a sheet of flame, and a cloud of smoke, the gases go into action. Operating a camera, one of the researchers photographs a battery of instrument dials that reveal such vital facts as the thrust of the motor and the weight and pressure of the gases surging through pipes from metered chambers.

But the rocket itself, instead of soaring into the heavens, remains rooted on the ground, since it is



anchored in place and pointed earthward. For Edward S. Forman and John W. Parsons, the California rocket researchers, are mainly interested for the present in studying the action of various fuels for stratosphere - stabbing rocket ships, and the effect of their intense heat on various types of nozzles.

This question of rocket-motor nozzles is one of the major problems now facing rocket experimenters, who are constantly devising new improvements and new methods to take the rocket out of the realm of fantasy and into the field of practical use. Booster motors to assist rocket take-offs, gyroscopes to guide flights along straight paths, water-cooled nozzles, range finders to record altitudes and speeds, automatic

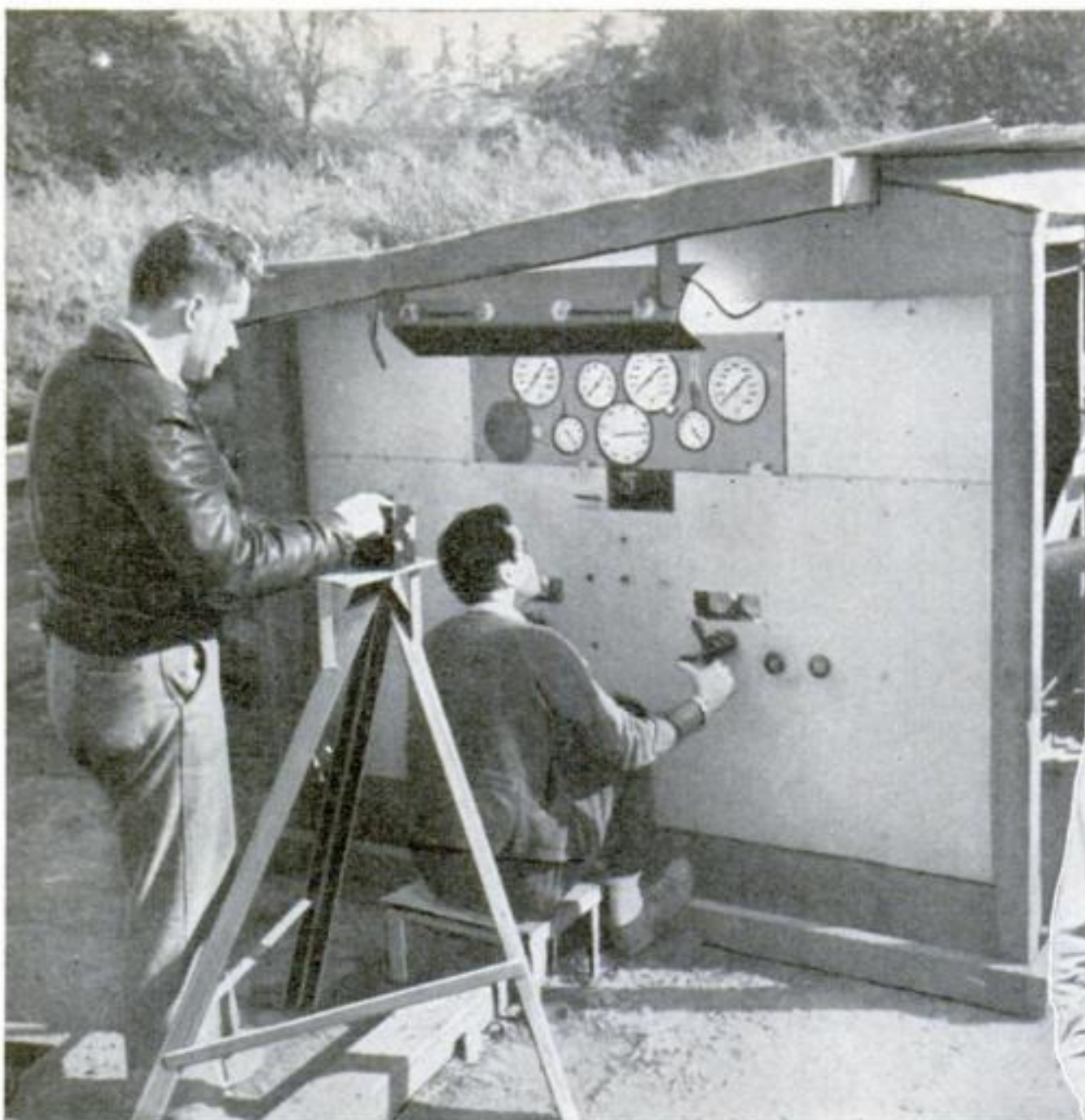
parachutes that return the rockets safely to earth—these are some of the devices that are now being tested and brought to perfection by laboratory experiments on a dozen fronts.

North of Roswell, N. M., for instance, rockets wobble skyward from a sixty-foot tower, and then straighten out into a true vertical path, soaring up two miles into the air at a speed of more than 700 miles an hour. At the top of their flight, they hang in air a split second, then tumble over and float gently down to earth as their parachutes automatically belly out. The gyroscopic mechanism that straightens out the initial take-off wobble is a development engineered by Dr. Robert H. Goddard, rocket pioneer. Stabilizing vanes attached to the rocket are automatically controlled by the gases of the

By ROBERT E. MARTIN



John W. Parsons preparing an experimental rocket motor for a test. At the left, gases burning at 3,000 degrees centigrade shoot out of a tiny nozzle. The general view at the far left shows the sandbagged outdoor laboratory that is used by Parsons and his associate, Edward S. Forman



MEASURING KICK OF ROCKET GAS

While Forman operates controls that set off the charge in a rocket pointed at the ground, Parsons waits to take pictures of instruments recording the pressure created. Below, carbon lining of rocket motor



exhaust stream, moving the rocket back into line when it wanders ten degrees away from a vertical path.

But actually how close is rocket science to practical exploration of the stratosphere at an altitude of, say, fifty miles? Studies at the California Institute of Technology lead investigators to believe that with the exhaust velocity of 7,000 feet a second obtained by Goddard's rockets, powder rockets could now be built capable of rising 100,000 feet. In fact, under some conditions, they believe a gas-propelled, eighty-five pound rocket, exhausting its burned fuel through a nozzle at the rate of 12,000 feet a second, could rise under power to an altitude of fifty miles, and then continue, "coasting," straight up for another 175 miles.

For more than three decades scientists have sought ways to explore the atmosphere at great heights. Today their thoughts are turning to levels where rockets would fly through a vacuum, and celestial observations might be made without interference from city lights, haze, clouds, or air molecules of lower altitudes. One well-known astronomer even went so far as to suggest the possibility of a complete astronomical observatory, raised a thousand miles above the earth by one set of rocket motors, and maintained at that level by another.

Of more immediate practical application is the proposal that rockets take over the duties of heavy artillery in laying down a concentrated bombardment of an intensity not reached even with dive-bombing airplanes and the latest type of field and railway guns. Major James R. Randolph, of the U. S. Army Ordnance Reserve, recently declared that rockets could easily equal the performances of long-range guns firing shells as far as seventy miles.

These long-range cannon fire a projectile eight inches in diameter. "Instead of firing shots of moderate caliber at long intervals," said Major Randolph, "a rocket plant could fire the equivalent of twenty-four-inch shells as fast as desired."

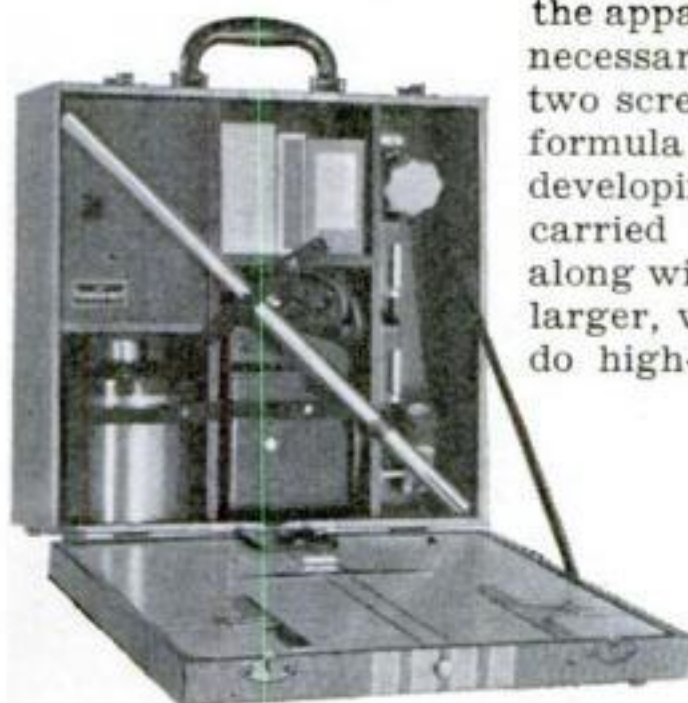
Projectiles envisaged by this officer would weigh four tons. Thousands of them, set off simultaneously or in volleys, might lay down in a few minutes a withering barrage that present artillery could equal only over a long period of time.

Armor-piercing rockets, Randolph further proposed, could be carried by submarines, while on land, the rocket shells could be transported in ordinary motor trucks bearing no resemblance to artillery weapons now easily identified by enemy planes.

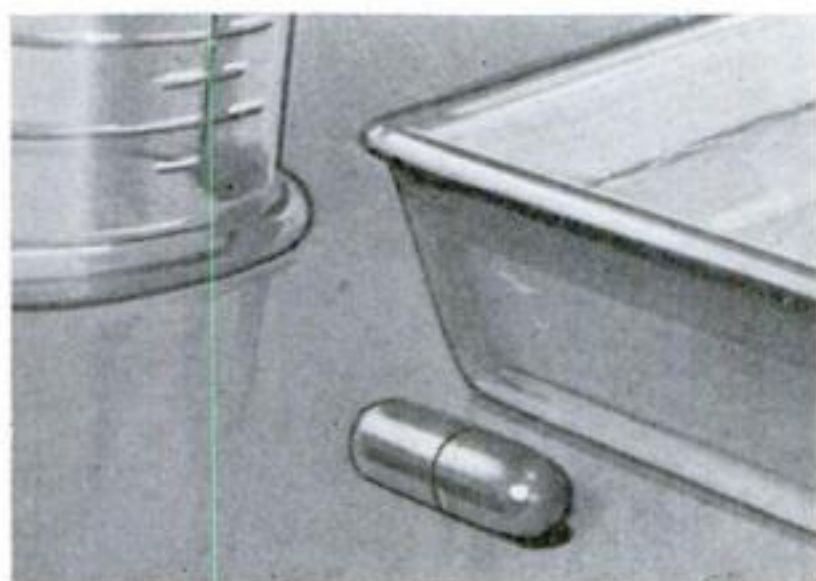
Portable Enlarging Outfit Fits in Traveling Case

SO COMPACT it can be carried in a luggage-type case only four inches longer than this page, a new miniature enlarger permits travelers to turn any hotel room or tourist-camp cottage into a darkroom for enlarging. To set up

the apparatus, it is only necessary to tighten two screws. Chemicals, formula cards, and a developing tank can be carried in the case along with the little enlarger, which is said to do high-grade work.



Portable enlarger in its carrying case. It makes a darkroom of any place you may be



This capsule is dropped in the film container

Sensitizing Powder Comes in Handy Capsule Form

STEPPING up the speed of either movie or still film from fifty to 100 percent, hypersensitizing chemicals in powder form are now offered for sale in capsules. To increase the speed of the film, all that is required is to drop one of the capsules in the film container and leave it there the required length of time. The chemicals in the capsule, which will keep for years, according to the manufacturer, act upon the emulsion and increase its sensitivity. There is nothing to spill or come in direct contact with the film.

Combined Film Projector and Viewer



Projecting enlarged images of transparencies on a wall. They can also be viewed on a built-in screen, as at right



TRANSPARENCIES can be either viewed or projected by means of a compact, double-duty accessory recently placed on the market by a New York manufacturer. When the transparency is slipped

into place, a movable mirror throws the image on a viewing screen. If the user desires to see the picture enlarged, he simply turns a knob and the mirror swings out of the way, permitting a lens to project the magnified picture on a wall or screen for more detailed examination.

New Accessories for

Prints Colored with New Tints Are Ferrotyped

COLOR^{ED} photographs now can be ferrotyped and given a high gloss through the use of chemical tints which are sold in blotterlike strips and applied with pipe cleaners for brushes. When pieces of the strips are dropped in water, they produce the coloring fluid used on the photographs. This fluid sets quickly so the print can be soaked in water after the coloring is completed, and then ferrotyped.



The coloring fluid is made by dissolving strips of paper in water

Exposure Meter Shows Density of Negatives

FOR DETERMINING the relative density of color-separation negatives, a new device makes use of a conventional photo-electric exposure meter. The meter is placed on top of the apparatus where it receives light projected upward through a negative. The denser the negative, the less the light reaching the meter. A special scale attaches to the regular meter.

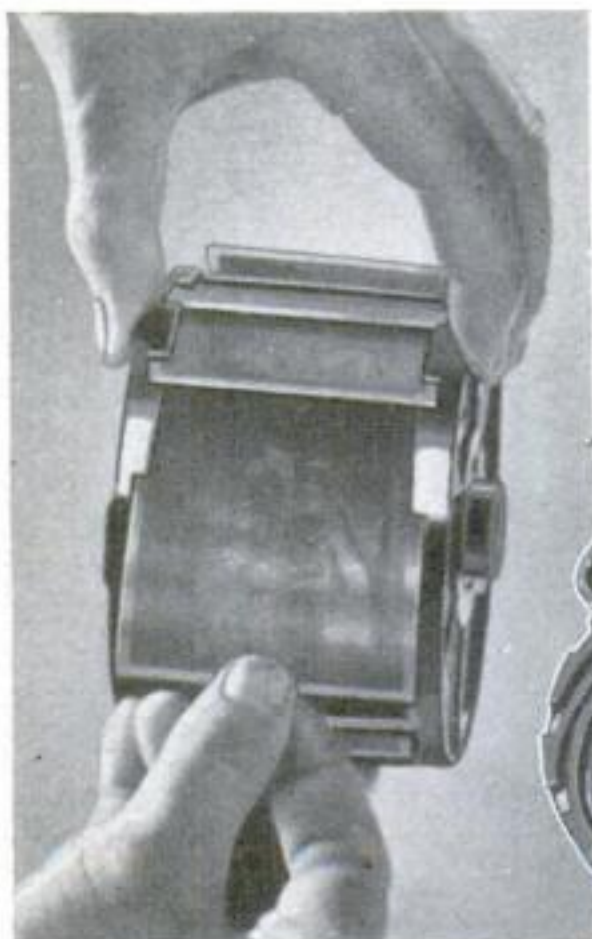


Using an exposure meter to gauge density of negatives

Compact Circular Developing Tank

Parts of the new circular developing tank, shown assembled at left

MORE compact than the conventional rectangular developing tanks for cut films and film packs, a new circular product with a spiral-groove reel permits the amateur to develop his films with a minimum of chemicals, according to the manufacturer. By sliding the top section of the synthetic-resin reel up or down, films ranging all the way from 35 millimeters to 2½ by 3½ inches can be accommodated.



Camera Enthusiasts



An opaque coating keeps light from leaking from the neck of this bulb. At the right, two lamps are in use



Light-Tight Necks for Photoflood Bulbs

BLACK necks on mushroom-type photoflood bulbs now prevent stray light from spilling out and shining in the lens of the camera. Such lamps are designed with an interior aluminum reflecting surface which

makes the use of a conventional reflector unnecessary. The new opaque coating, extending from the base of the lamp to a point beyond the beginning of the reflecting surface, makes the neck light-tight.

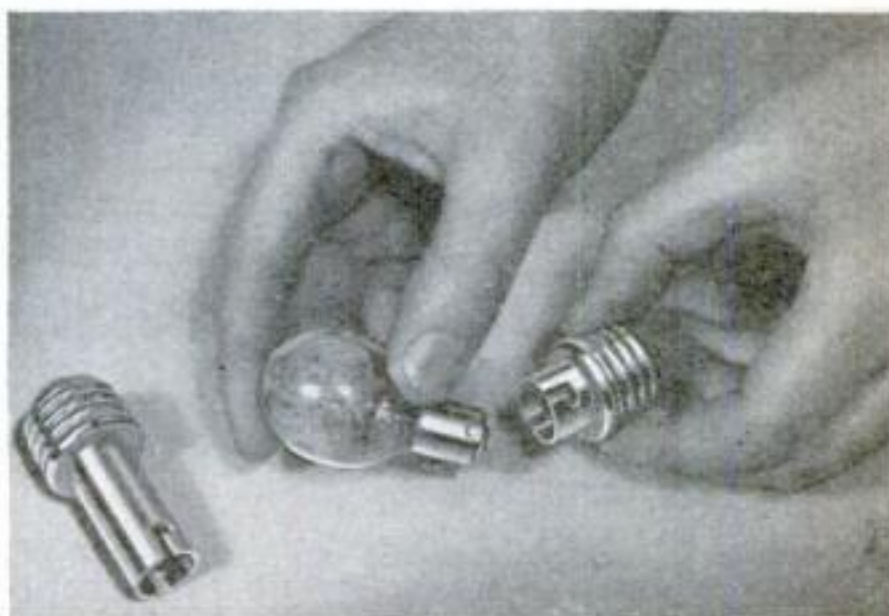


Socket Adapters Center Midget Flash Bulbs

TO CENTER midget photoflash bulbs in standard-size reflectors, nickel-plated socket adapters are now available. One end of the device screws into the regular socket of a flash gun. The other is slotted to provide a bayonet lock which facilitates rapid re-loading. One size of the adapter, with a short stem, is for small reflectors; another size, with a longer stem, for large ones.

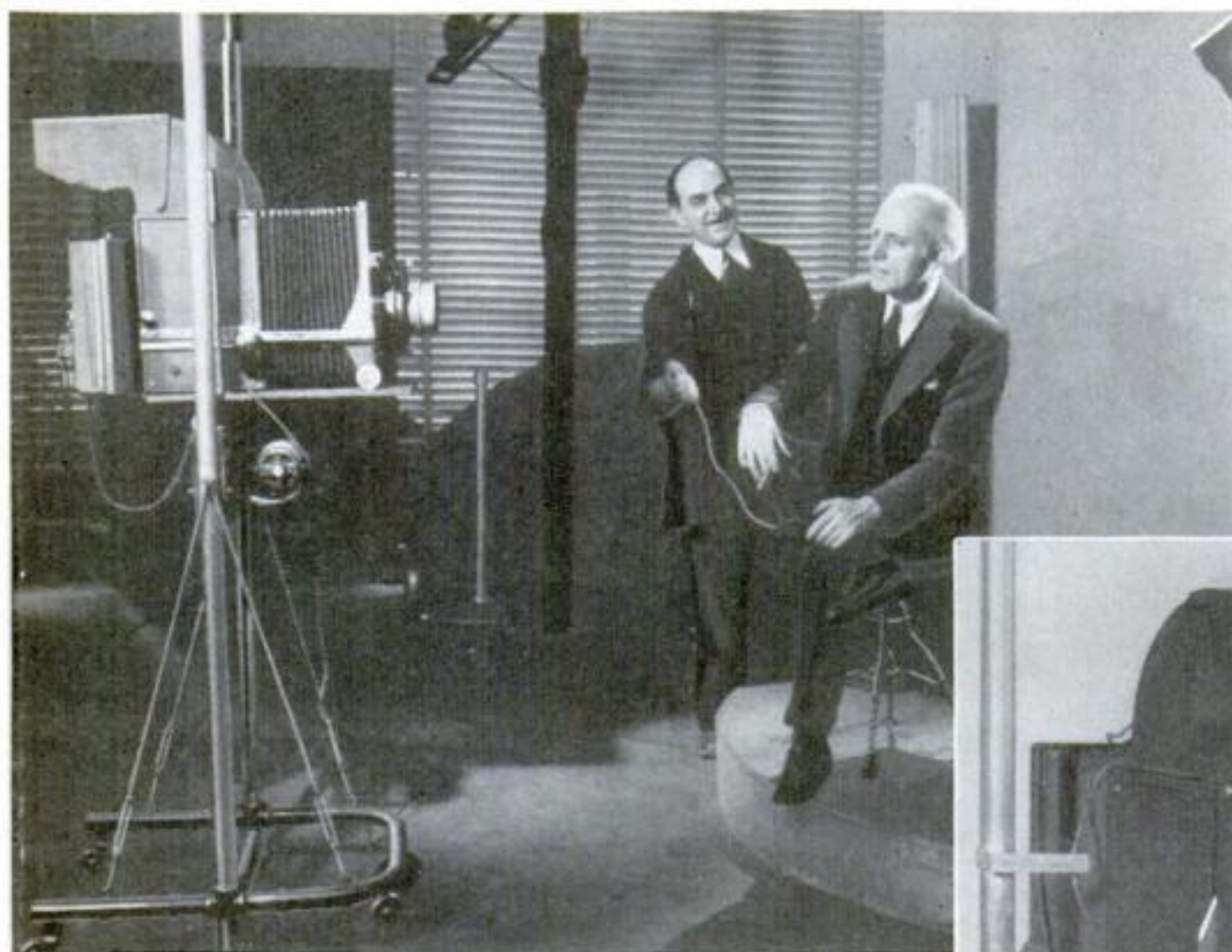
Spotlight on Flash Gun Aids Focusing in Dark

FOCUSING in reduced daylight or at night is simplified by a small spotlight which plugs into the battery case of an American-made flash gun. Whenever there is insufficient outside lighting for using the range finder or the ground glass of the camera for focusing, the beam of the little spotlight will provide a spot of illumination for the purpose. The lamp can be plugged into the flash-gun outlet in a moment. The attachment also provides a test for the strength of the flash-gun battery.



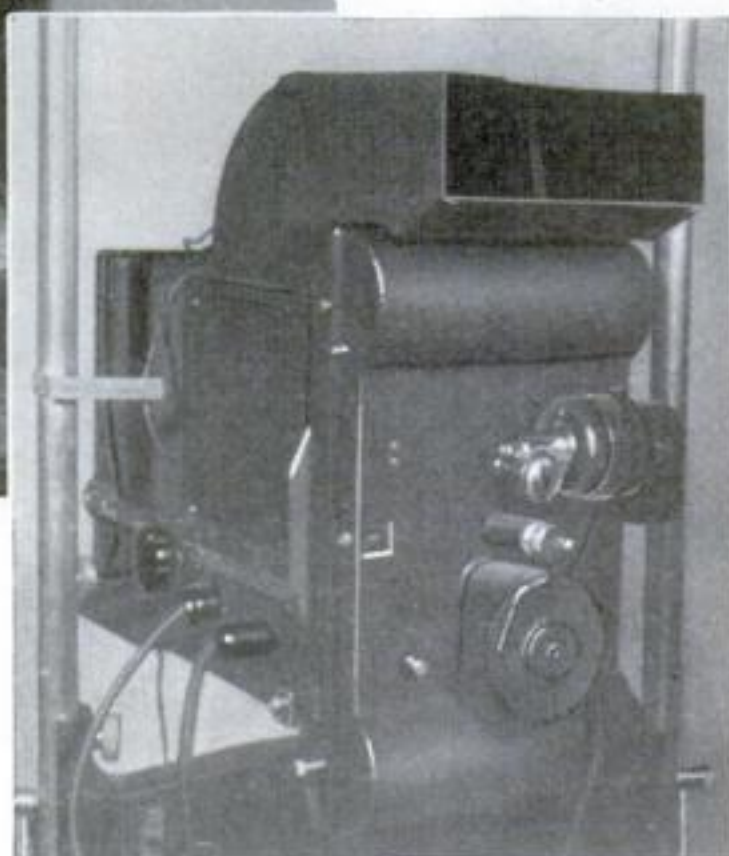
Two adapter sizes suit large or small reflectors

Studio Camera Is Remotely Controlled

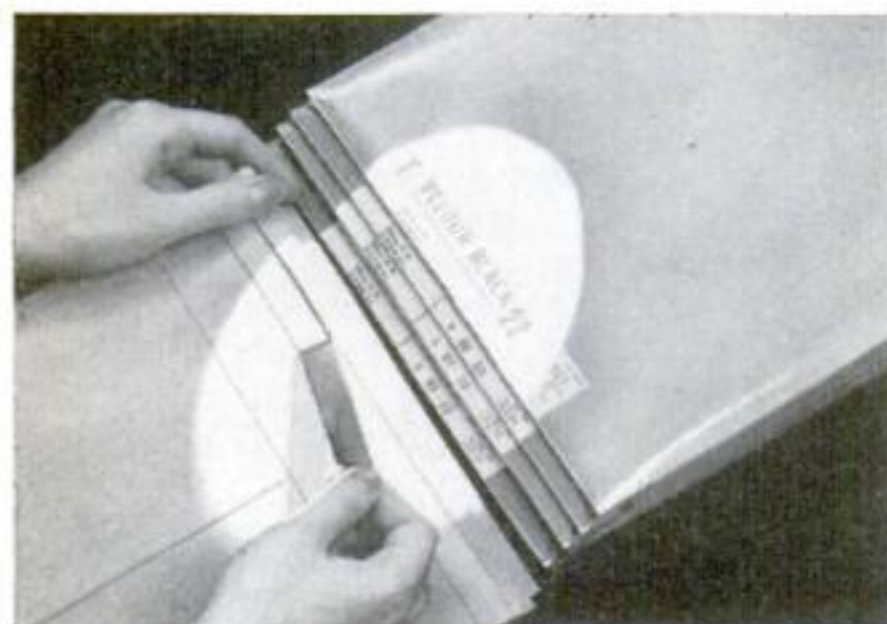


With this electrically operated camera, a photographer snaps the shutter from any point

Below, a rear view showing motor that turns the film, and shutter-speed dial



ELECTRICITY operates a new studio camera which George M. Walters, a California photographer, has perfected after sixteen years of research. A remote-control cable and switch enable the photographer to snap the shutter from any point in the studio. The electrically operated shutter permits 1/1,000th-of-a-second snapshots.

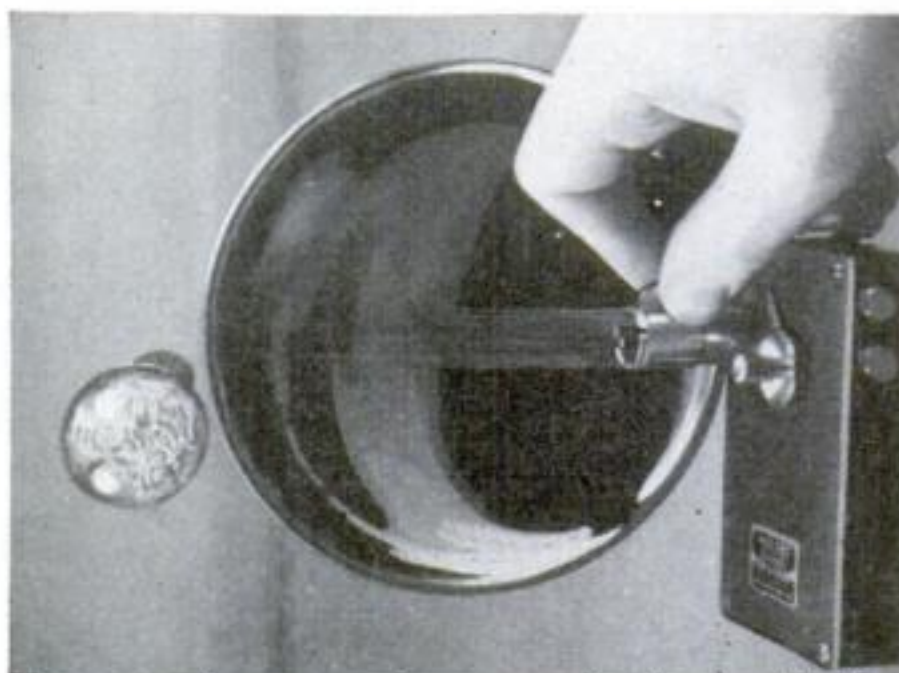


Enlarging Paper Packed in Perforated Envelope

TO SAVE trouble for the darkroom worker, one American manufacturer of enlarging paper is incorporating a perforated strip in the flap of the package. By gripping a tab at the end of the strip and pulling sidewise, the user can rip off the perforated section and quickly open the package, leaving a narrow flap to protect the contents.

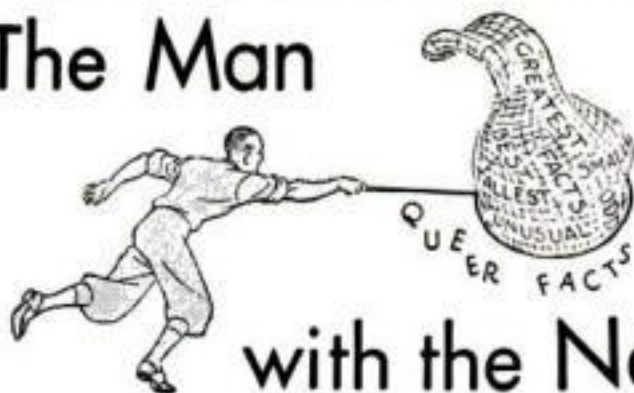
New Extension Adapter Ejects Used Bulbs

BURNED fingers are prevented by a new extension adapter for synchronizers, which contains a built-in ejector for "peanut-size" flash bulbs. Slight pressure on the ejector forces out the hot used bulb and makes handling unnecessary.



Pressing the ejector forces out the hot used bulb

The Man



with the Net

RAILROAD TIES in the United States are replaced at the annual rate of 100 ties a mile.

HYDROCHLORIC ACID is being used in England to give concrete highways a rough, nonskid surface.

FALLING through the doors of moving automobiles kills an average of 300 persons a year in the United States.

AMERICAN bombing-plane engines cost approximately ten dollars a horsepower.



AUTOMOBILE TRAFFIC in Times Square, New York City, averages six miles an hour, five miles an hour slower than the average speed of horse-and-buggy days.

RED BLOOD CELLS are manufactured in the human body at the rate of 30,000 a second.

MOUNTAIN-TOP LICHENS, it is estimated, live for 1,000 years.

PRUNE-PIT OIL has been found to be exceptionally rich in vitamin A.



KENTUCKY LEGISLATORS once passed a law to the effect that Robert Fulton did not invent the steamboat.

EVERY SECOND of the year, an average of about 16,000,000 tons of rain and snow fall on the surface of the earth.

NOVA SCOTIA'S coast line is three times as long as the entire Pacific coast line of the United States.

KANGAROO TAILS provide fibers which are used for thread in certain types of surgery.

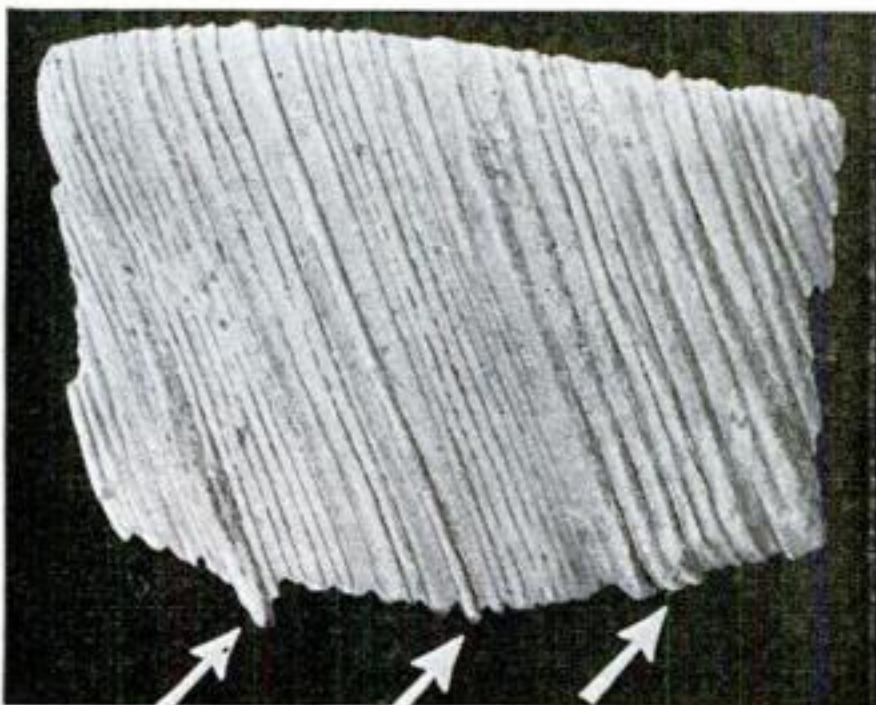


Spade with Two Handles Symbolizes Friendship

TWIN handles on a Y-shaped spade recently enabled American and Canadian officials to symbolize friendship while breaking ground for a new Niagara Falls bridge.

Ancient Sun-Spot Cycles Wrote Record on Clay

PREHISTORIC sun spots left their record on the clay bottom of a western river, scientists recently discovered. Just as the growth rings of trees show that every eleven years a season of extra rain results from sun-spot activity, so the clay deposits are thicker at similar intervals.



Arrows show thicker layers caused by unusual rains

POPULAR SCIENCE

Question Bee

We've added a little variety to our quiz for your entertainment. Try to pick the right answer to complete the first five sentences. Then follow instructions for the rest. Answers are on page 223



1 You would be safest from lightning (a) in swimming (b) standing beneath a tall, isolated tree (c) under your bed (d) within a steel-framed office building.

2 A diamond-back terrapin is (a) a highly venomous snake (b) a piece of expensive jewelry (c) a turtle prized as a table delicacy (d) an issue of paper money guaranteed by Treasury deposits of diamonds.

3 If one of your car's cylinders fails to fire, the trouble may be a faulty (a) spark plug (b) flywheel (c) transmission (d) odometer.

4 To save weight in building ships and other steel structures, riveting sometimes is replaced by (a) pickling (b) welding (c) vulcanizing (d) electroplating.

5 A half hitch is a kind of (a) swimming stroke (b) auto-trailer coupling (c) knot (d) belt for a repair man who climbs telephone poles.

Answer "Yes" or "No"

If you aren't sure, try for a good guess

6 Are bats blind?

7 Do U. S. battleships fire torpedoes?

8 Should a hack saw be used to cut metal?

9 Is a spider an insect?

10 Can the pilot of a motorless glider ever soar higher than his point of take-off?

Censored Sentences

Each dash stands for a letter in the same missing word in each sentence

11 A ——— is a small burrowing animal; but a ——— is also a skin blemish, or a ——— may be a breakwater to shelter a harbor.

12 A carpenter smooths wood with a ———; three points determine a ———; a ——— is useful to an aviator.

13 You would need a ——— to change a tire; a deck of playing cards contains four ———s; a ——— is a kind of flag; telephone-switch-board connections are made with ———s.

14 A carrot is an edible ———; two is the square ——— of four; money has been called the ——— of all evil.

15 You could fill a drinking glass from the ———; a ——— is a light knock; a machinist uses a ——— to form internal screw threads.

Pairing Them Off

Can you supply the missing word commonly associated with the other? Dashes represent letters

16 Flora and ———.

17 Block and ———.

18 Latitude and ———.

19 Stress and ———.

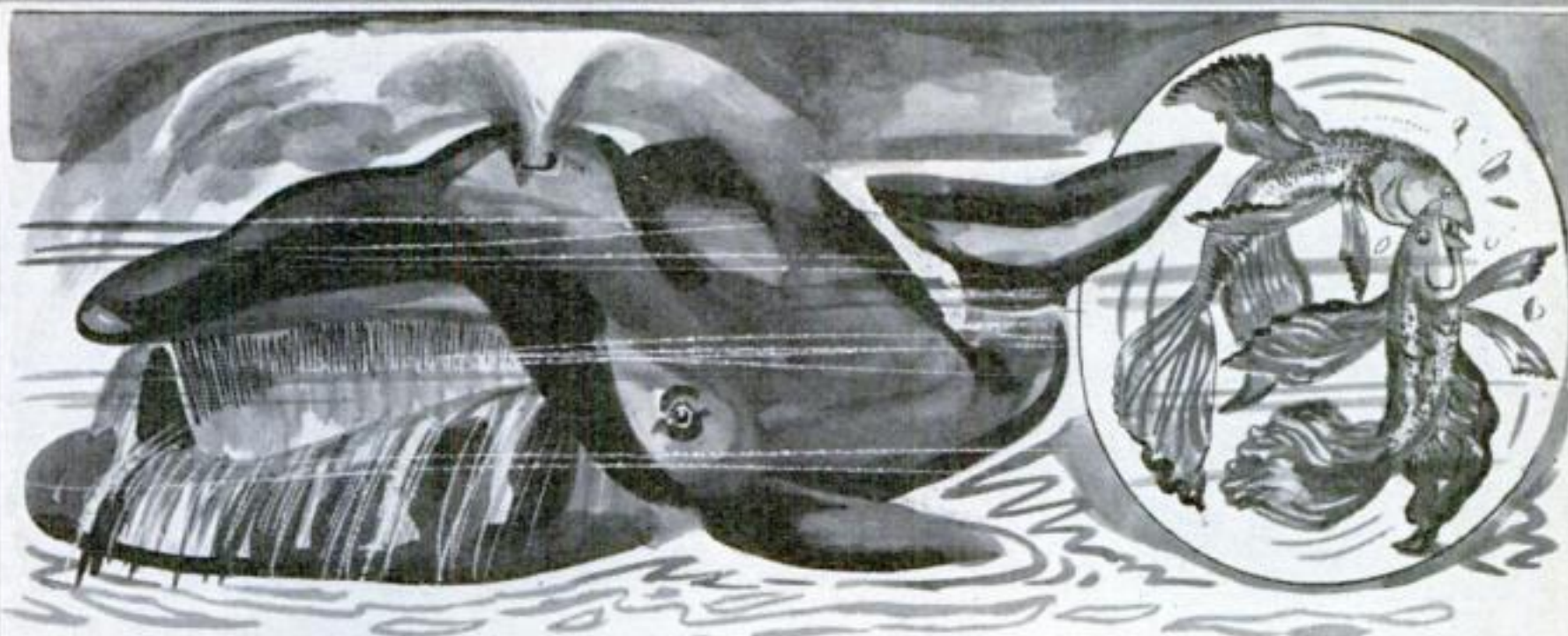
20 Brace and ———.

Now YOU Ask US One!

We pay \$1 for each question accepted. Address the Question Bee Editor, Popular Science Monthly, 353 Fourth Avenue, New York City.

Un-Natural History

By
Gus Mager



THOUGH THEY ARE THE LARGEST MAMMALS IN THE WORLD, **WHALES** ARE, IN GENERAL, THE MOST PEACEFUL CREATURES THAT INHABIT THE SEA!

ON THE OTHER HAND, THE DIMINUTIVE **SIAMESE FIGHTING FISH** IS A NATURAL-BORN KILLER, THE MALES ATTACKING EACH OTHER SAVAGELY!



AMONG LAND ANIMALS, THE HUGE **ELEPHANT** IS AN INOFFENSIVE, GRASS-EATING BEAST, WHILE THE TINY **SHREW** IS A VICIOUS MEAT EATER AND A CANNIBAL!

THAT BIRD GIANT, THE **CONDOR**, IS A COWARDLY CARRION FEEDER, BUT THE PYGMY **HUMMING BIRD** IS A FEARLESS, PUGNACIOUS SCRAPPER!



WHEN FRIGHTENED, THE **HOGNOSE SNAKE** PUFFS HIMSELF UP TO LOOK LIKE A BIG, DANGEROUS REPTILE. IF THIS BLUFF DOESN'T WORK, HE ROLLS OVER AND PLAYS DEAD! WHAT A FAKE!



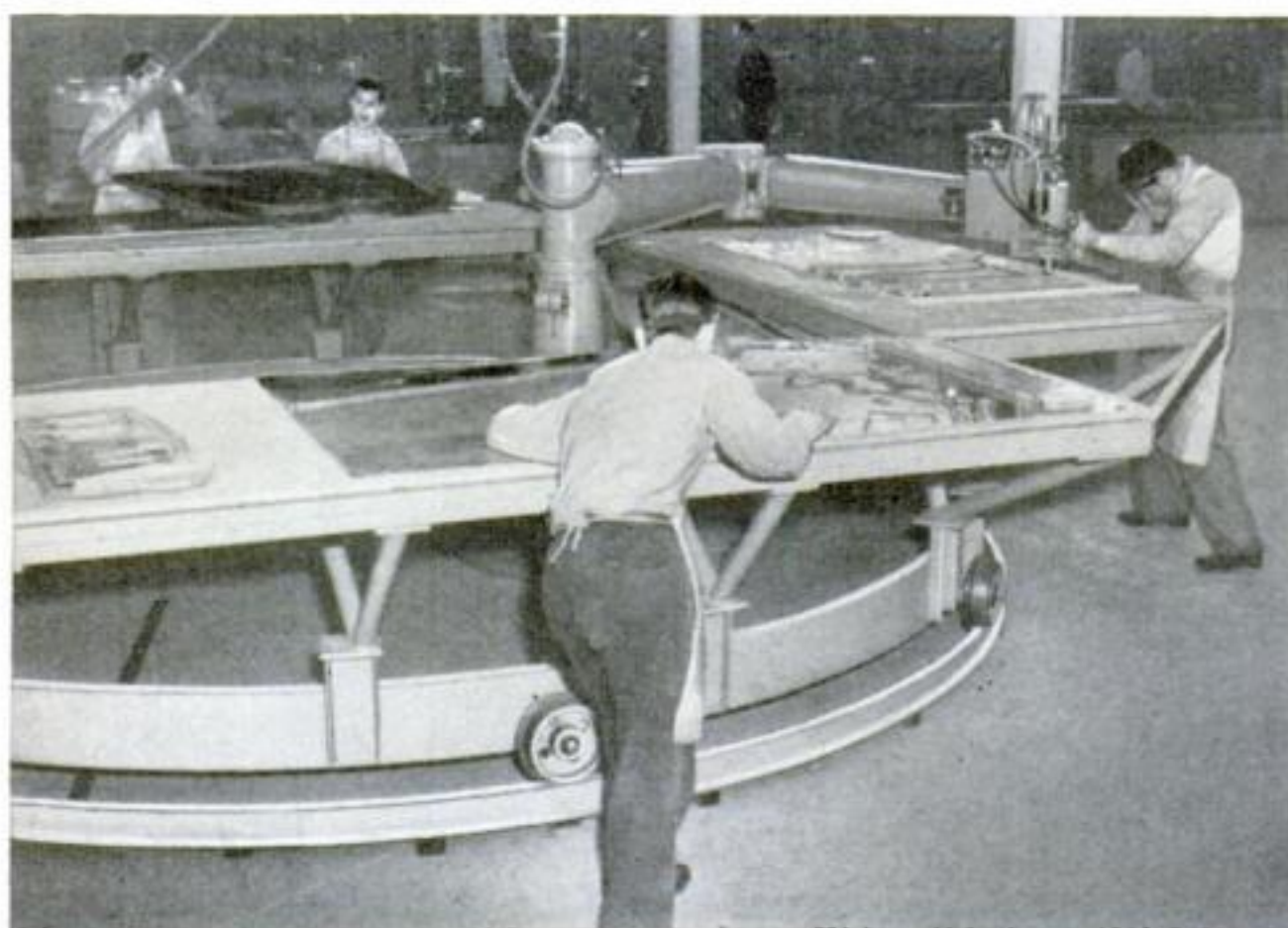
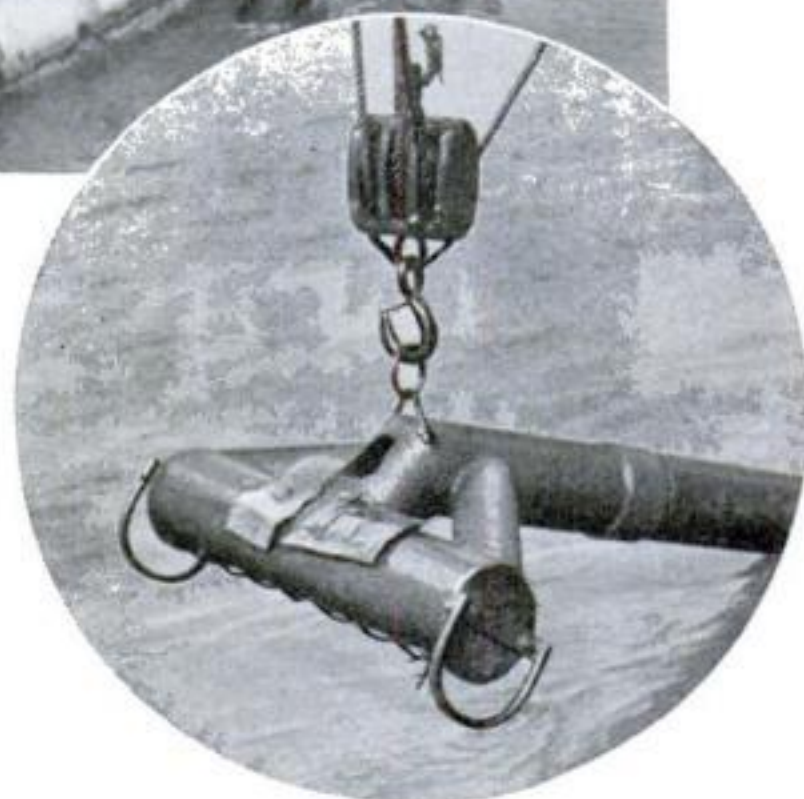
ALL **FISH** ARE DUMB, PRACTICALLY DEAF, AND HAVE ONLY THE CRUEST SENSE OF SMELL! THOUGH THEY POSSESS A WELL-DEVELOPED NERVOUS SYSTEM, THEY ARE ALMOST INSENSIBLE TO PAIN!



Screening coal from the mixture of mud and sand sucked from a river bed by the "vacuum cleaner" seen at right

Coal Mined from River Bed with Pumps on Odd Barge

PENNSYLVANIA miners are using an odd river barge to reclaim some of the fine particles of coal washed into the Susquehanna River from near-by coal fields. Through a pipe dragged along the river bottom, coal mixed with mud and sand is pumped to the surface, where it is extracted by screening.



Turning the tables brings a new batch of work to the machine operator

Tables Turn To Speed Up Production

TO SAVE valuable time, four work tables are mounted corner to corner on a circular track in a California aircraft plant. When two operators have each routed a table load of sheet-metal parts with routing machines mounted on swivel arms, the tables are turned, bringing a new batch of work in front of each operator without loss of time.

Model Rooms Aid in Planning Decorations

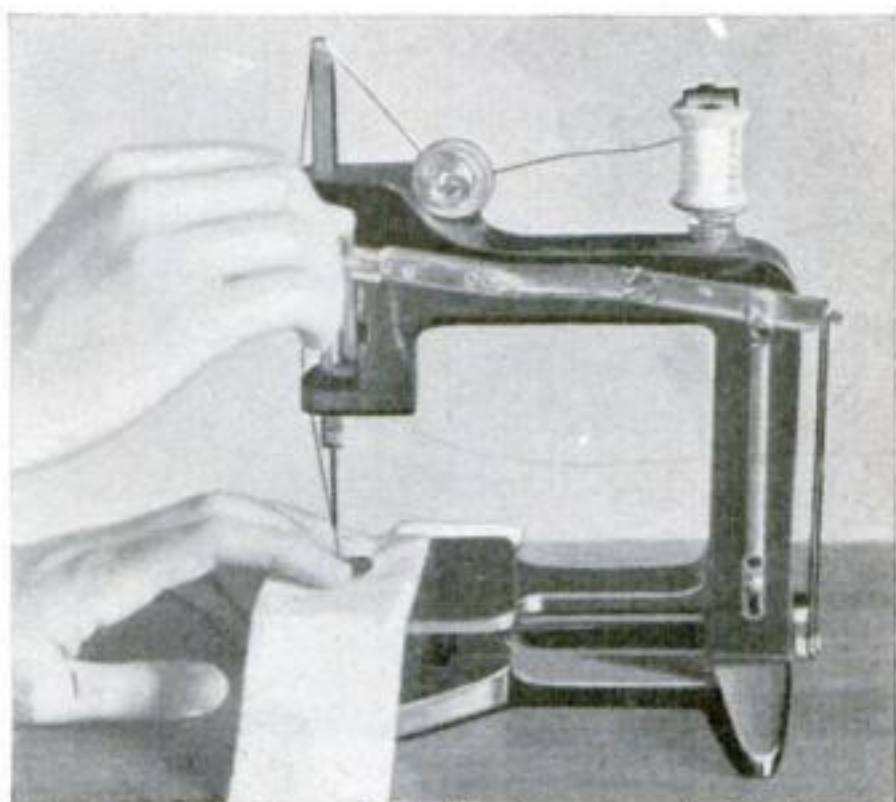
TO ASSIST brides and other prospective home decorators in planning the furnishing of various rooms before they set off on a buying spree, a novel decorating kit has been introduced. With scissors and paste, floors and walls of individual rooms may be built to scale out of heavy paper. Then various cut-out forms representing furniture may be spotted about the model room to help the decorator decide what to buy and where to place it. Shopping lists and full directions are included in the kit.



Planning decorations with cut-outs and a model room from the kit

Button-Sewing Machine Does the Job Quickly

BUTTONS can be sewed in place within a few seconds, with a novel machine invented by Harry A. Landis, of Red Lion, Pa. As shown in the photograph below, the button is held with the first two fingers of the left hand, while the thumb and forefinger of the right hand pump a needle bar up and down. The vertical needle bar automatically moves horizontally so that the needle will enter the eyes of the button in order. A small clamp accessory furnished with the machine holds small buttons, snaps, and hooks and eyes that would be difficult to hold by hand.



Button sewer in use. Needle bar is worked by hand



Chemically Treated Pads Keep Dogs' Coats Clean

COTTON pads saturated with a special lotion make it easy to clean dust and dirt from a dog's hair, to keep the animal's coat in first-class shape between baths. Eight inches square and packed eight to a jar, the pale-blue pads contain a disinfectant as well as a cleaning agent. The pads, which may also be used to swab and clean cats' fur, are said to be harmless to even the most sensitive skin. They are specially recommended for the care of city pets.

New Conveniences



VEGETABLE CUTTER. Potatoes and other vegetables are cut to various sizes and shapes by this accessory, as a lever forces them against interchangeable cutting blades set in either end

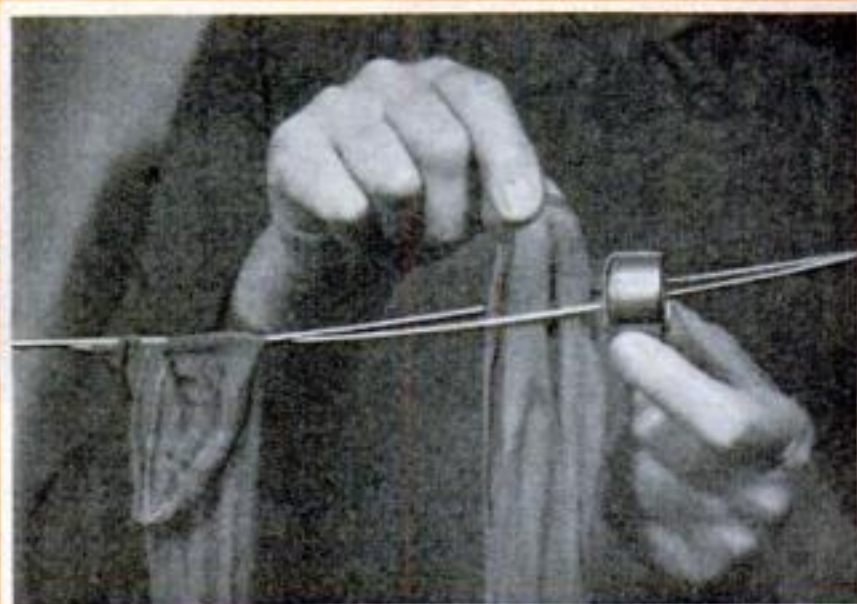
WEATHER FORECASTER

Changes in the weather are foretold by the ornamental barometer at the right. It consists of a pear-shaped glass globe with a graduated inner tube. The water level in the tube reflects changes in the atmospheric pressure



METAL CLOTHESLINE

Two twisted metal wires replace cord in the clothesline below. No clothespins are used, as garments are gripped between the wires, which are separated for the purpose by sliding a pulley along the line. Rustproof, the wires will not stretch



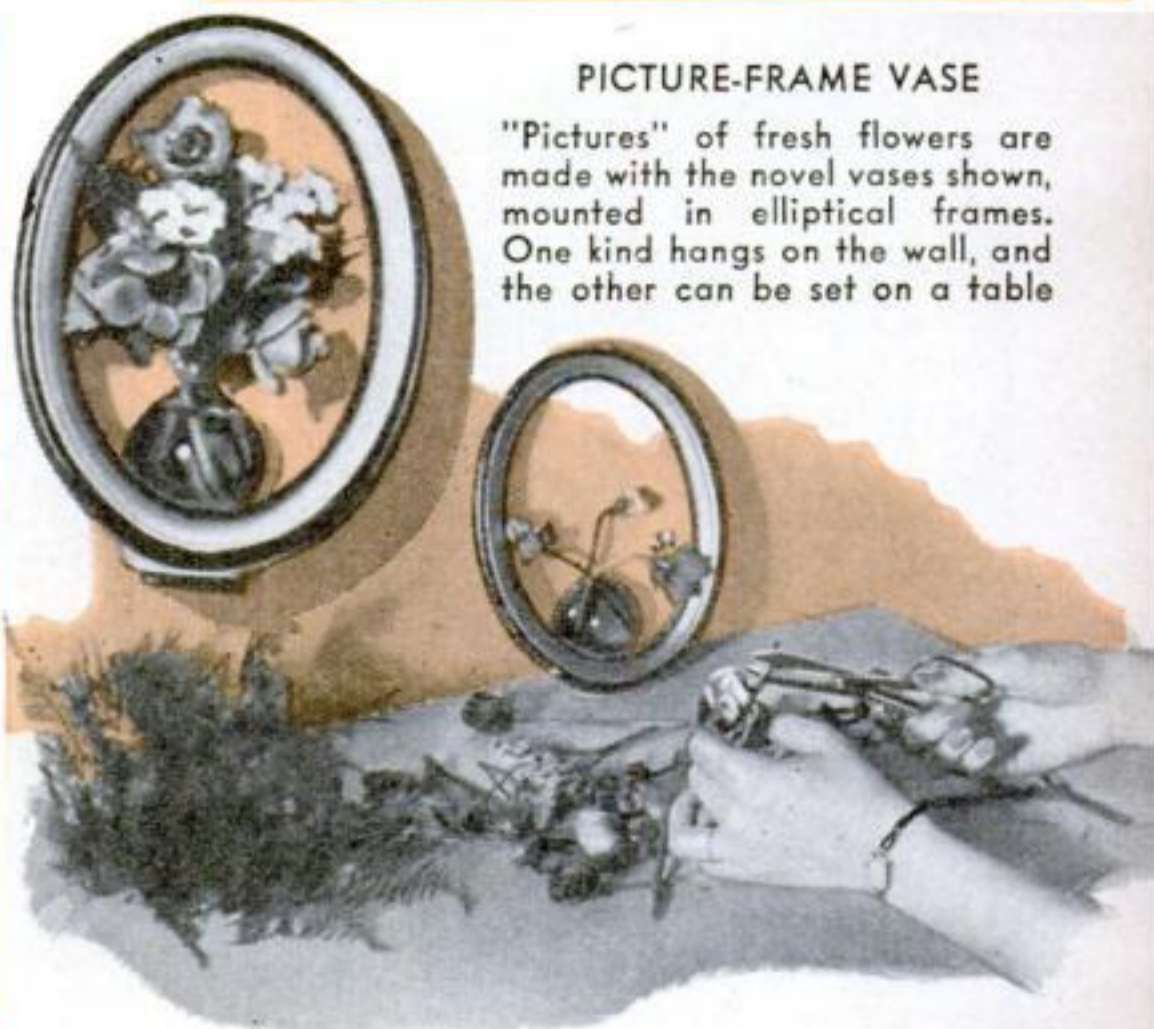
VACUUM JUG HAS FAUCET

Air pressure created by squeezing a rubber bulb on the vacuum jug below forces liquid from a spout

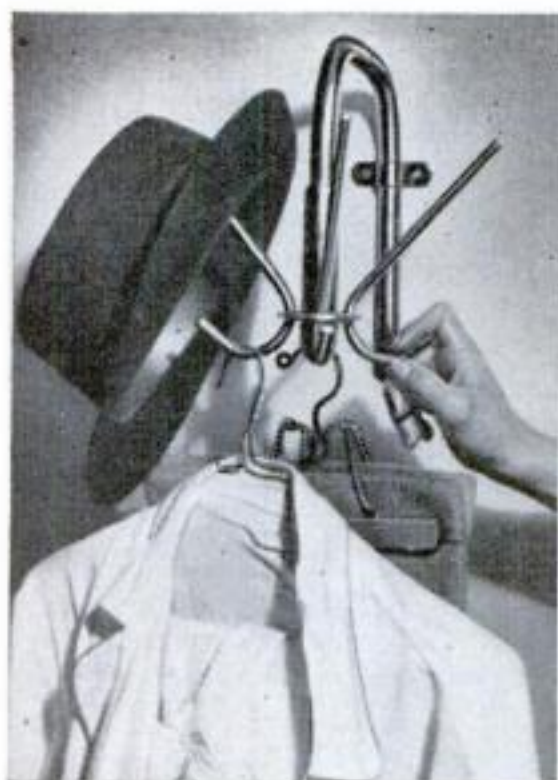


PICTURE-FRAME VASE

"Pictures" of fresh flowers are made with the novel vases shown, mounted in elliptical frames. One kind hangs on the wall, and the other can be set on a table



for the Household



WALL CLOTHES TREE

Fastened to a closet wall or door, this handy rack has all the advantages of a standing clothes tree. Its top rotates for more convenience

TWO-WAY SHAKER. Divided into two sections, a new table accessory dispenses either salt or pepper. Pressing a lever, as shown below, shuts off the salt and releases pepper



TRANSPARENT CAP. Made from a transparent rubber product, a novel cap protects the hair-do from water in the shower. It can also be used as a dust cap and for outdoor sports



FOUR-IN-ONE AID

A work chair, ironing board, bedside table, and stepladder are included in a versatile new combination unit. When it is used as a chair, as seen above, the ironing board becomes the back rest



BRIDGE-TABLE SLING. The problem of storing the bridge table between parties is solved by the sling shown below. Made out of heavy denim, it has pockets in which corners of the table fit for hanging up in a closet





This plant will have a good home while its owner is away

Plants Are Boarded at Hothouse Hotel

A BOARDING HOUSE for house plants is now in operation in the suburbs of New York City so that householders planning to be away from home on business or vacation trips can leave their plants in safe hands. The plant-nursery fees range from twenty-five cents a month for a geranium plant to ten dollars a month for a large, tub-planted orange tree. All rates are American plan.

Milk Is Kept Fresh by Novel Process

PRESERVING milk in hot weather without ice or refrigeration is said to be made possible by a new process. Gases are first removed from the fluid and replaced with oxygen. Then the milk is "smothered" with oxygen for several hours under pressure at from 104 to 176 degrees F. Saturated with oxygen in storage, it is said to keep for several weeks at room temperature.

Model Homes Built with Ready-Made Kits

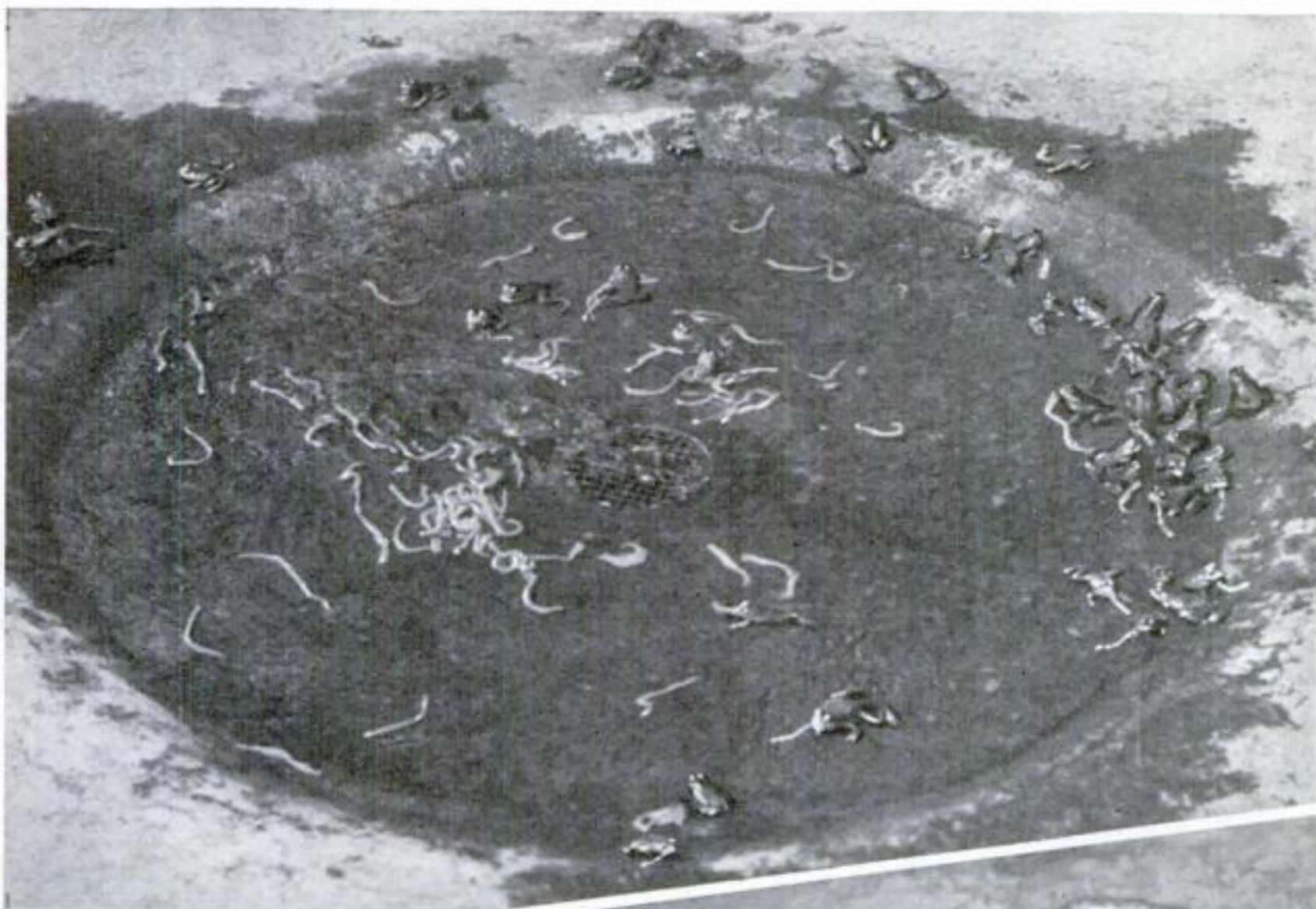
MODEL homes are built easily with construction kits now available. Various outfits for a large variety of house styles have parts ready to assemble, although they are left unpainted to allow the owner to select his own color scheme. Walls and roof are wood panels resembling siding and shingles, while doors and windows come in units ready to slip into openings.



Completed model house of early American design. Right, putting a window frame in place



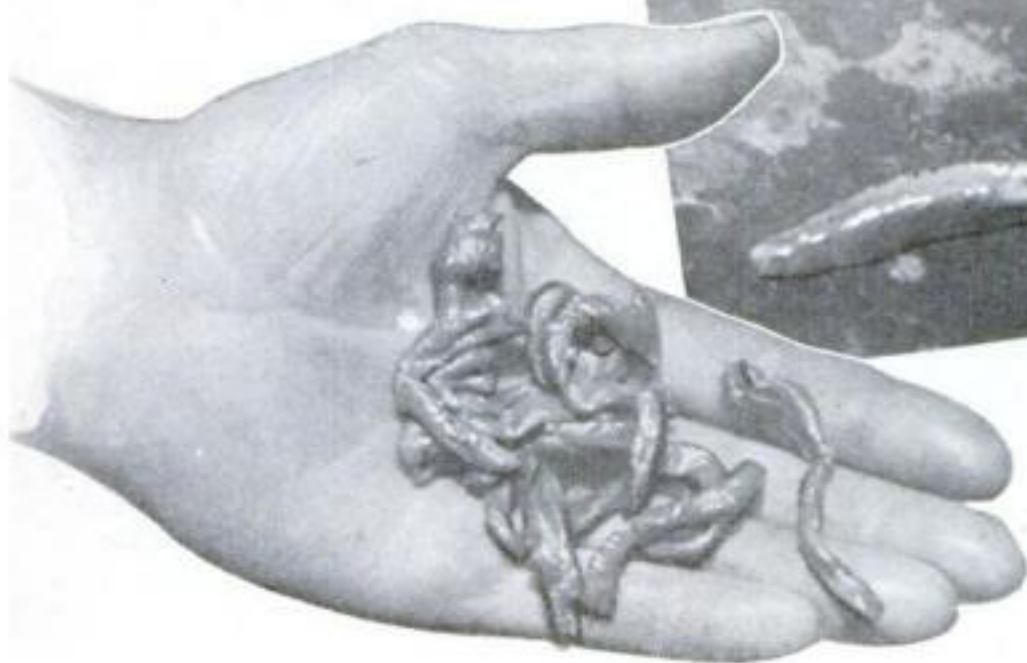
Horse-Meat "Worms" Fool Frogs



Wriggling like worms in the agitated water of a pond, horse-meat strips look appetizing to frogs



Mmm, this is good! The novel frog diet, samples of which are seen at the left, makes raising croakers more profitable



TRICKING frogs into eating horse meat by making them think it alive is the solution worked out by H. L. Parker, of El Monte, Calif., for the problem of diet in domestic bullfrog breeding. For twenty years, Parker has been experimenting in raising frogs as a food delicacy. Recently he decided to try feeding his frogs on a horse-meat menu, since he found it practically impossible to provide the frogs' natural live diet of vast quantities of minnows, insects, and earthworms. He contracted with the owner of a near-by lion farm for a supply of

horse meat, the regular food of captive lions. This he chopped into strips about the size of worms and tossed into his concrete frog tanks. Eddies of water created by a high-pressure water jet from a pipe animated the meat strips and made them appear to swim about on the surface. Frogs came hopping from all directions and snapped up the morsels with relish. Now Parker buys his own horses and has them butchered at a near-by processing plant to provide food for his amphibian livestock. Horse meat is fed to the frogs twice a week, and they thrive on it so well that Parker figures in seven months he can make about \$400 profit on an original \$100 investment, with a batch of 1,000 meat-eating frogs raised for the market.

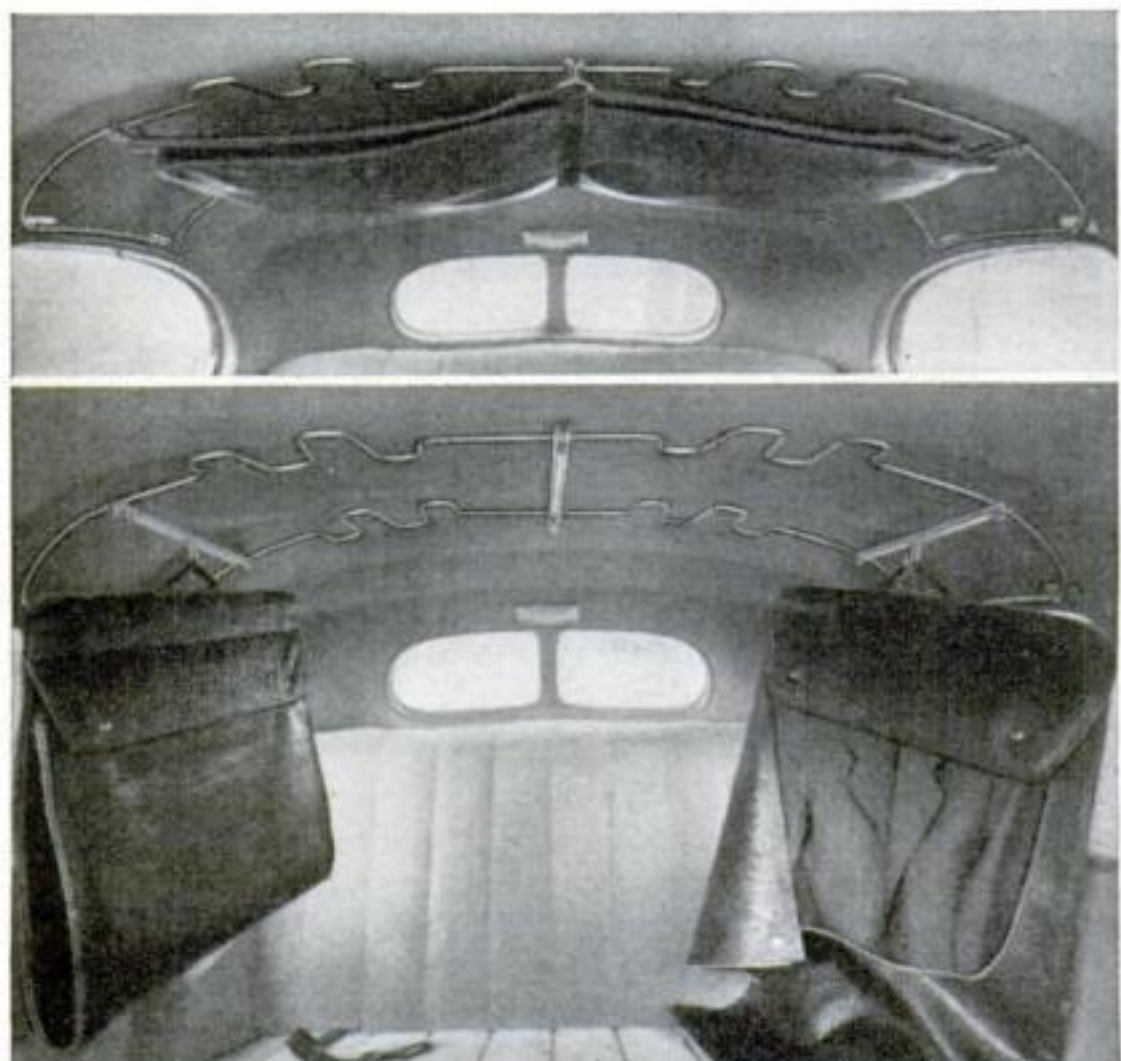
Glasses Let Color-Blind See Red Light



Through the special glasses, a color-blind driver sees light in the traffic standard only when the red or amber signal is shining

TO ENABLE color-blind motorists to determine whether a traffic light is red or green, a New York City optical firm has just introduced special glasses. The spectacles are made in two sections, the upper consisting of a segment of dark-red filter glass, and the lower of clear crown glass, although optically ground eye-correction lenses may be employed for those who ordinarily wear

glasses when driving. With the spectacles on, the color-blind driver looks through the red filter section of the lenses as he approaches a traffic light. If he sees any light at all in the traffic standard, he knows that it must be either red or amber, the "stop" or "caution" signal, since the filter blocks out all rays emanating from the green "go-ahead" light, while admitting the others. Since eye specialists estimate that one person in every twenty-five is color-blind, the filter glasses should make an important contribution to the problem of increasing traffic safety.



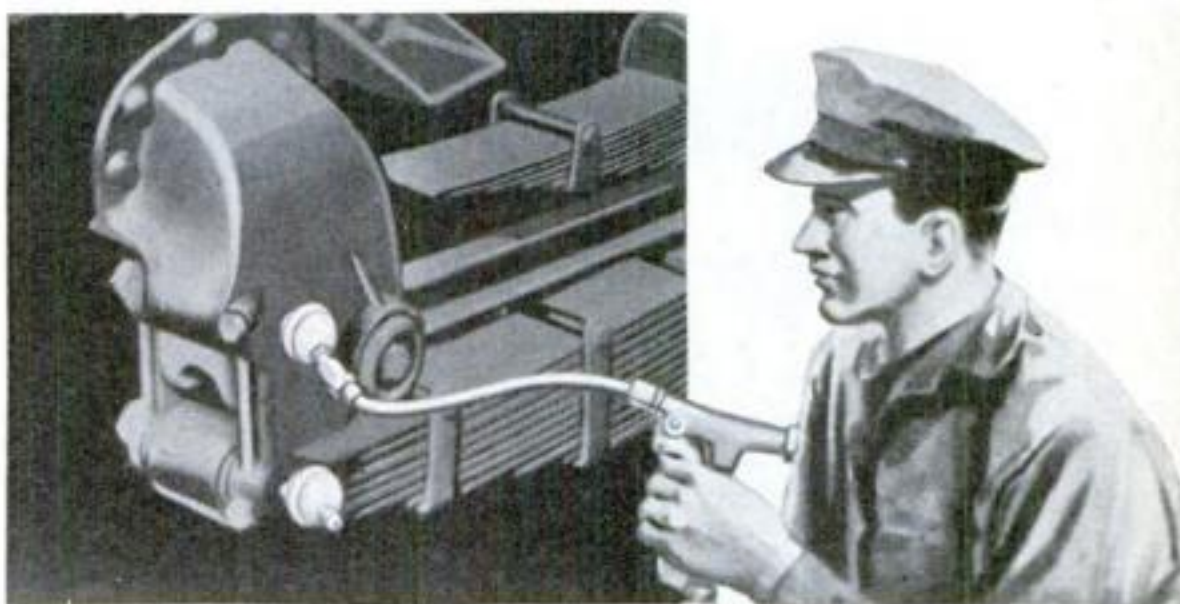
Garment bags open for inserting or removing suits. In the upper picture, they are strapped to the roof of the car for traveling

Car Travel Bags Strapped to Roof Out of the Way

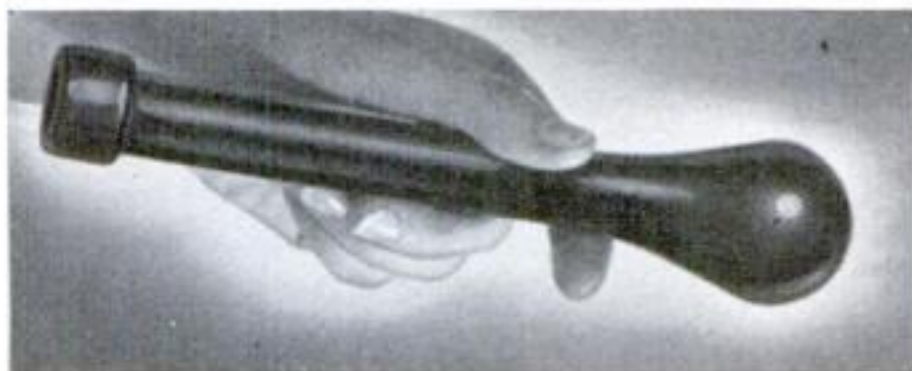
GARMENT BAGS that fit out of the way flush against the ceiling of an automobile are a new convenience for tourists and travelers. A wire framework fits snugly to the ceiling of the car, extending across from the top of one side window to the other. Two detachable garment bags, made of imitation leather and fitted with hangers, are suspended by a handle from each side of the wire frame. When packed, the bags are swung up into an overlapping position on the ceiling and held in place by straps and hooks, as shown in the upper photograph at the left.

Lubricator Feeds Grease Automatically

AUTOMATIC lubrication of springs, control arms, drag links, and other automobile bearing surfaces is accomplished by an ingenious fitting. The simple unit is a small steel sphere, having a grease-gun fitting and designed for insertion into bearing holes directly, or indirectly through adapters. A hollow, synthetic-rubber ball fills the interior until grease or oil forced into the sphere collapses the ball, and compresses the air within it. This compressed air tends to return the ball to its original round shape, a gradual process that pushes grease or oil into the bearing surface as the supply is used up. Each sphere holds a quarter of a fluid ounce.



Pumping grease into lubricator. A rubber ball, seen at left, expands to feed it gradually to bearing surface



Blackjack Shifts Gears

MADE of soft rubber with a lead-weighted ball at one end, the gearshift knob and shaft pictured at the left can be removed quickly for use as a weapon in case of a holdup or other emergency along the highway.

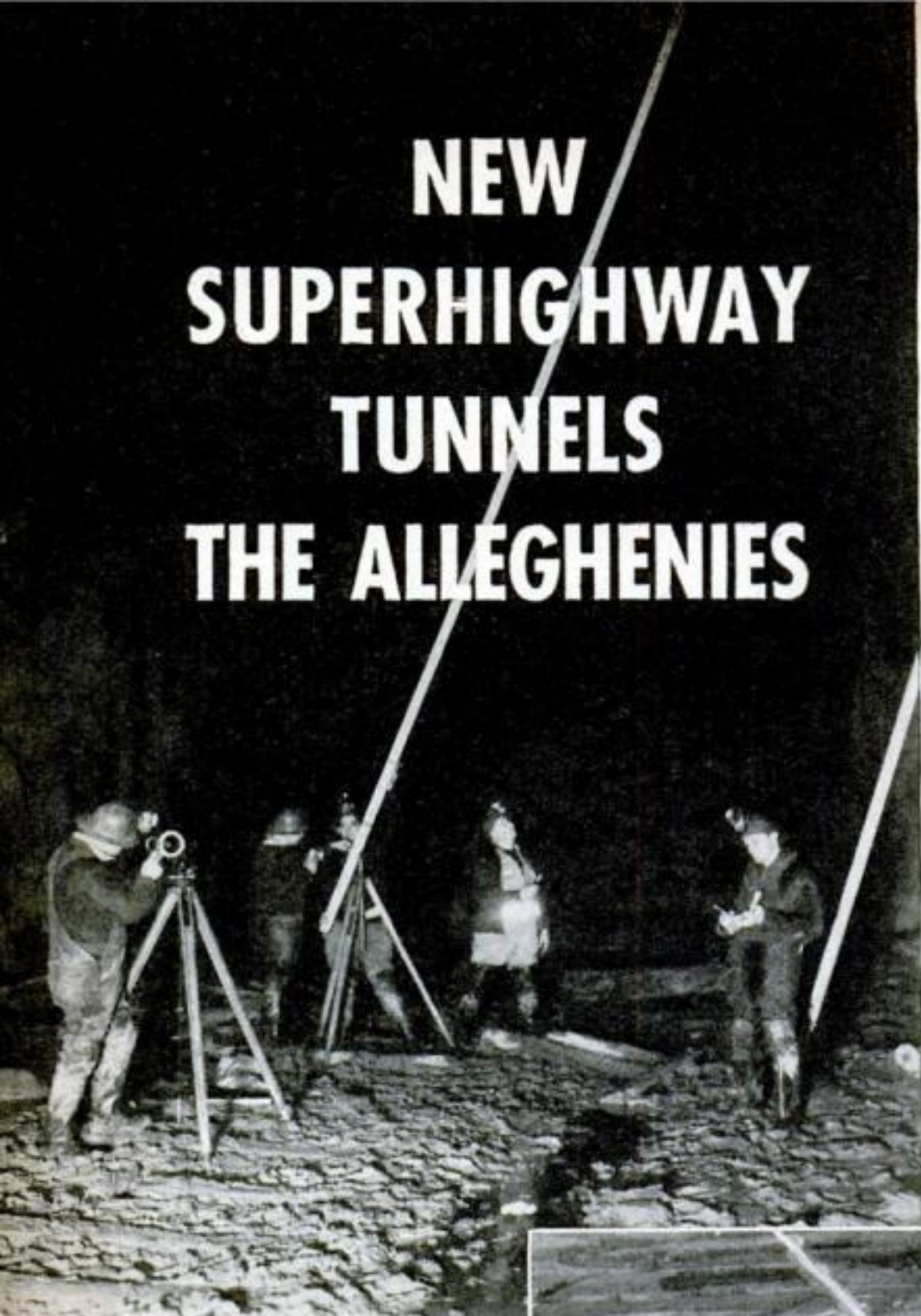


Signaling arm shows up plainly in light of the special lamp shown at the right

New Safety Light Makes Arm Signal Visible at Night

TO ILLUMINATE the arm of an automobile driver at night, as he extends it to signal a turn or stop, a Los Angeles, Calif., firm has just introduced a special safety light. Designed to fit within a car at the back of the driver's window, the safety light can be installed in any make of car within a few minutes. The accessory has been endorsed by the Los Angeles Police Department, which has installed a number of the lights in its radio-equipped patrol cars.

NEW SUPERHIGHWAY TUNNELS THE ALLEGHENIES

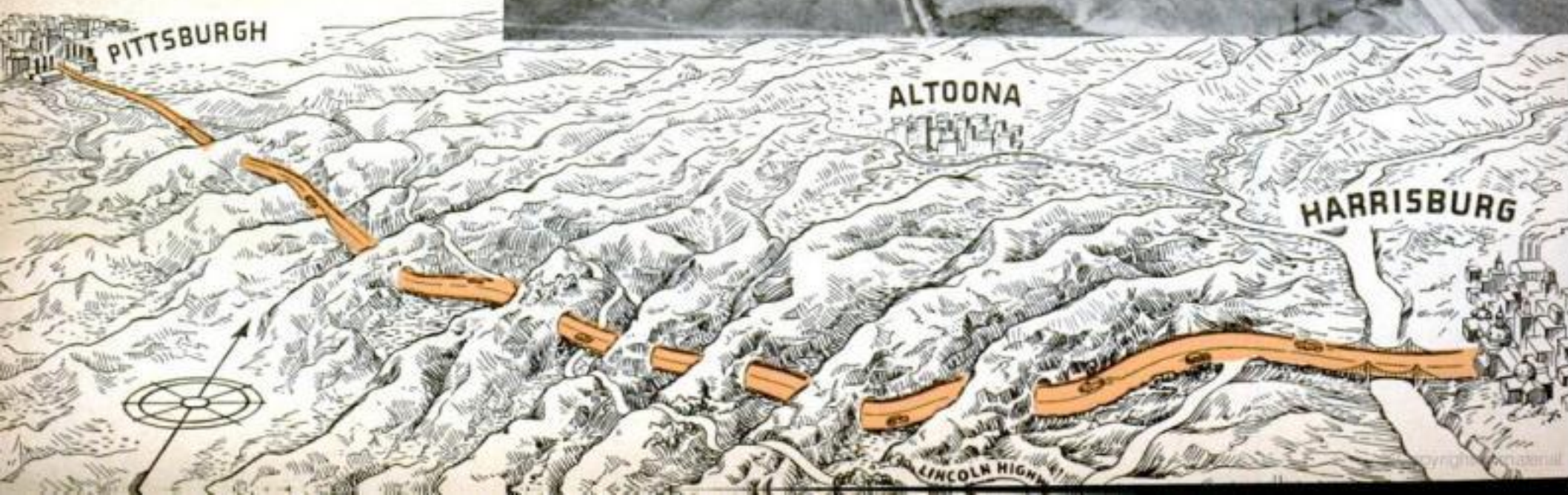


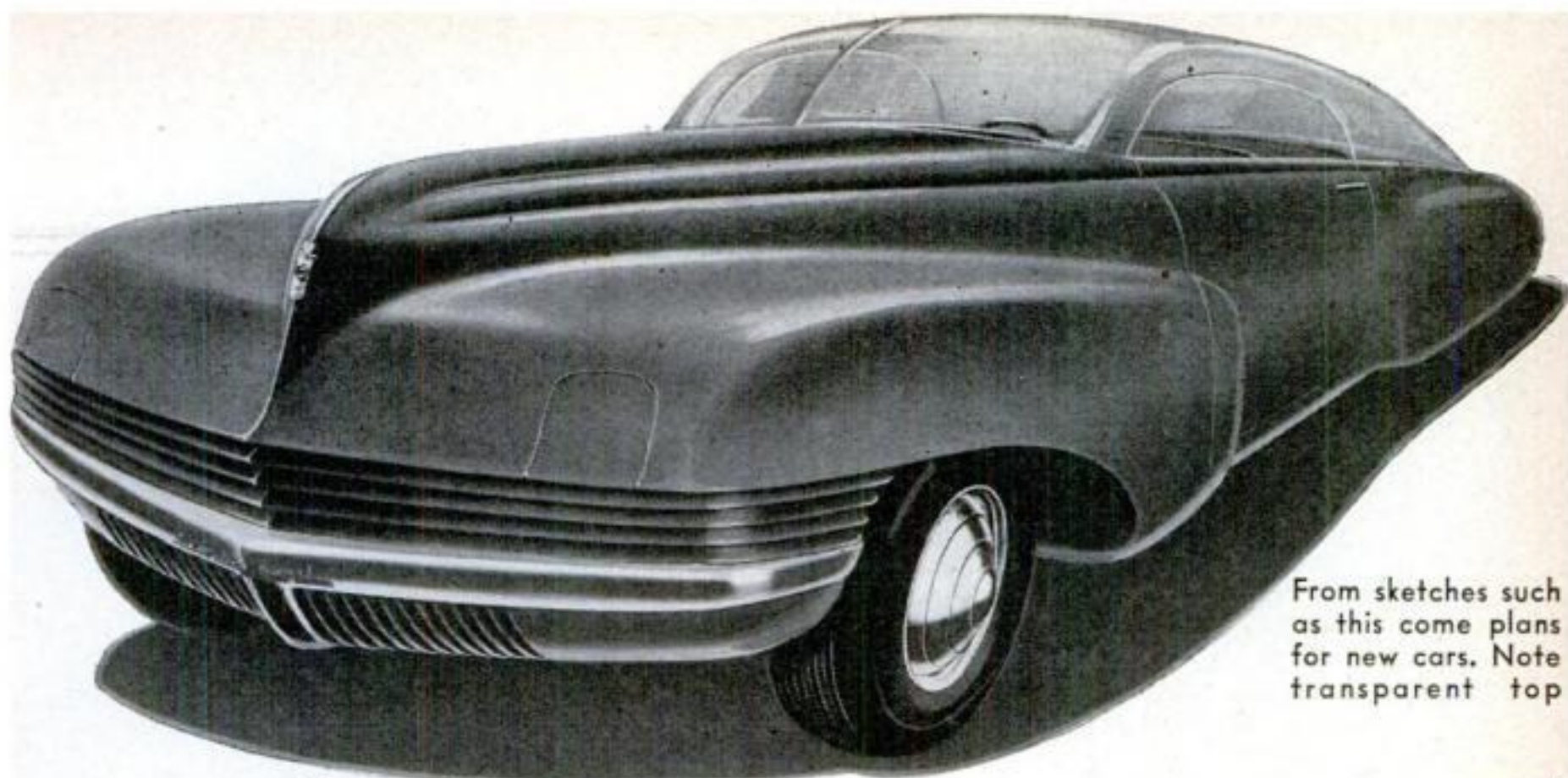
Wearing shockproof helmets, engineers survey one of the tunnel borings. The road narrows to two lanes in tunnels

A section of the high-speed, all-weather road from the Susquehanna to the Ohio. It has no grade-level crossings

A glance at the map below shows how all steep grades are avoided by the use of an abandoned railway bed and tunnels

STRIKING directly through the Allegheny Mountains instead of over them, a new 160-mile superhighway between Pittsburgh and Harrisburg, Pa., will be opened for the first time this summer. Following the road-bed of an abandoned railway, the superhighway leads through seven miles of tunnels, mostly dug by the railroad builders. Workers wearing special rubber-cushioned helmets, upon which a ten-pound rock could fall from a twenty-five-foot height without causing injury, completed the tunneling. The borings help to keep all grades at a maximum of three percent, permitting high-speed car and truck traffic over four concrete lanes. A motorist's dream, the highway has no cross streets, railroad crossings, towns, or traffic lights. Its construction reduces the total vertical climb in crossing the Alleghenies from 10,000 to less than 4,000 feet, materially reducing driving time, fuel consumption, and danger in winter on icy grades, while greatly increasing driving ease and comfort for motorists. Its route, with relation to the present Lincoln Highway, is shown in the map below.





From sketches such as this come plans for new cars. Note transparent top

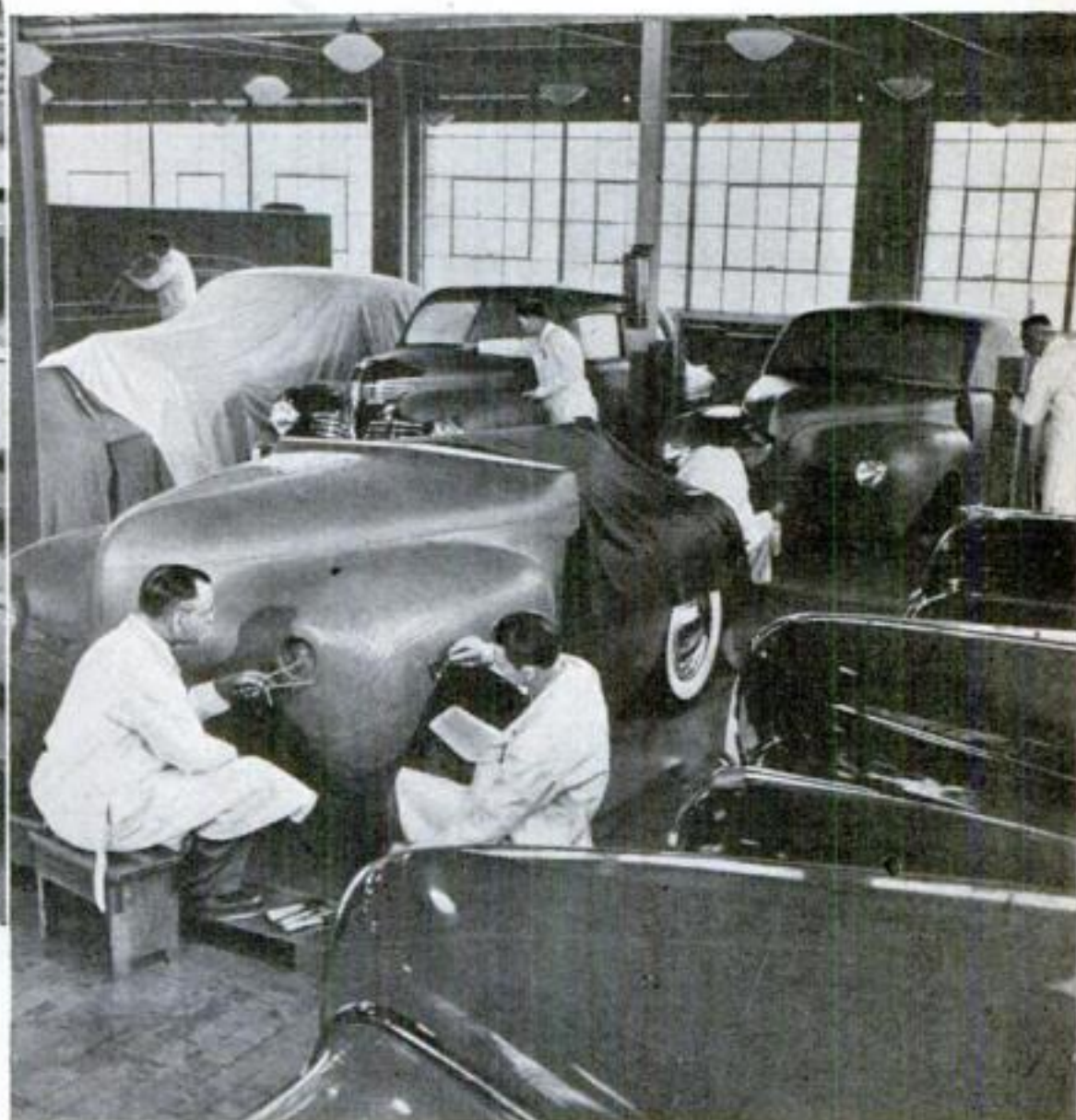
How the New Cars Are Designed

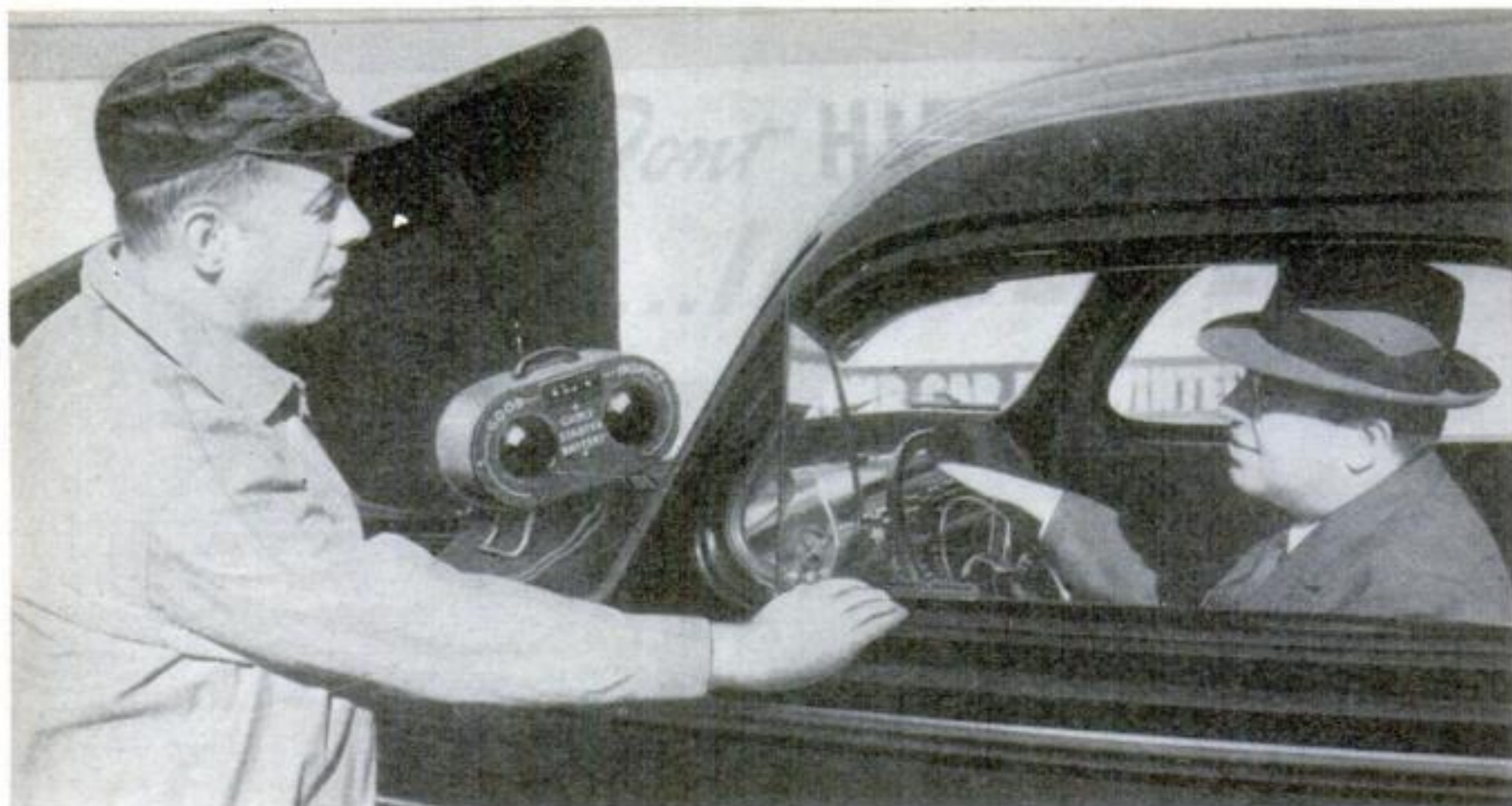
AN ARTIST sketches an exotic, streamline design on a giant blackboard. Sculptors model it full size in clay. Artisans carve it out of solid chunks of wood. Metalworkers fashion it in sheets of steel. Finally, a car of new and daring design is created, only to be driven virtually to destruction in brutal tests that will decide whether it shall be

scrapped, or become the newest product of a mass-production line. In the accompanying photographs, taken in the "art department" of the Chrysler Corporation, in Detroit, Mich., you see a few tentative models of the company's future cars. There, as in similar departments of other manufacturers, the endless process of improving the appearance and performance of cars goes on behind locked doors, to make your car of two or five years hence a reality.



Designing new dashboards. Right, making clay "mock-ups" of tentative models

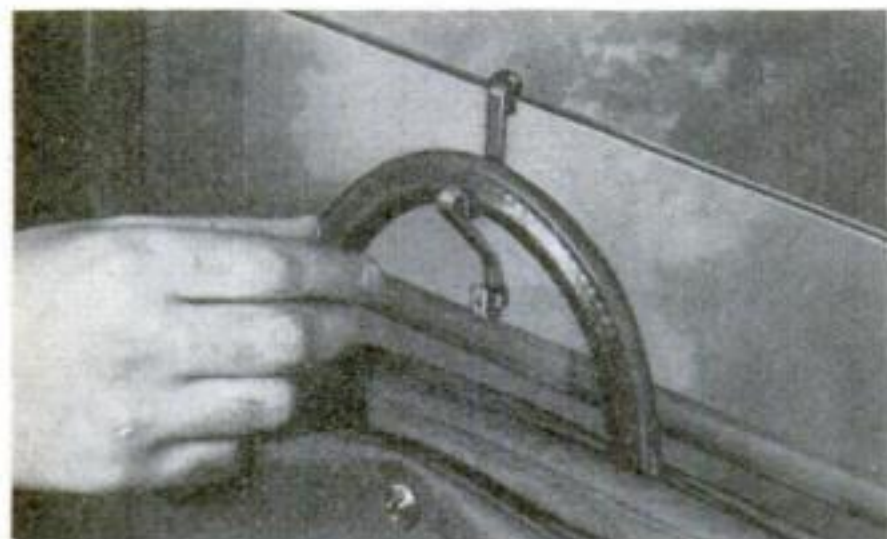




New Battery Tester Speeds Car Service

QUICK checking of the condition of car batteries without removing them from the car is possible with a new accessory for service-station attendants. Cables attached

to the unit are readily clipped to one battery terminal and the car's ground. As a motorist touches his starter button, visual indicators register the battery's condition.



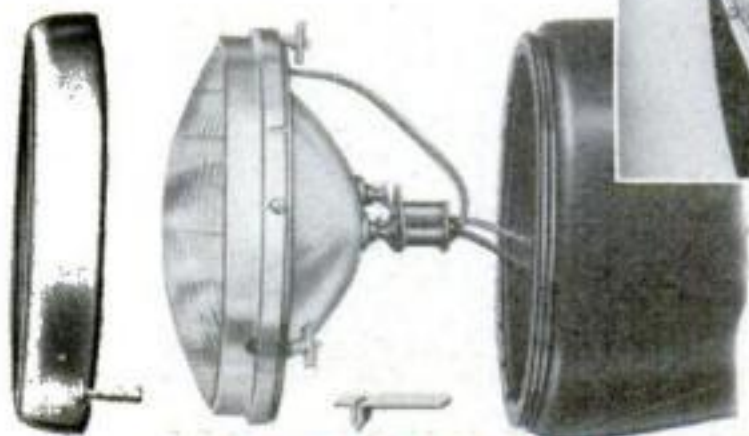
Rubber on this hook prevents scratching the window

Rattleproof Coat Hooks for Auto Windows

WINDOW HOOKS for car doors that do not interfere with opening or closing the windows have just been put on the market. Coat hangers, coats, and other articles hung on them are held securely in place. Because the hooks are amply covered by rubber, there is no danger of their injuring the window glass under normal vibrations, according to the manufacturer. In addition, they are effectively prevented from rattling.

Sealed-Beam Conversion Kits

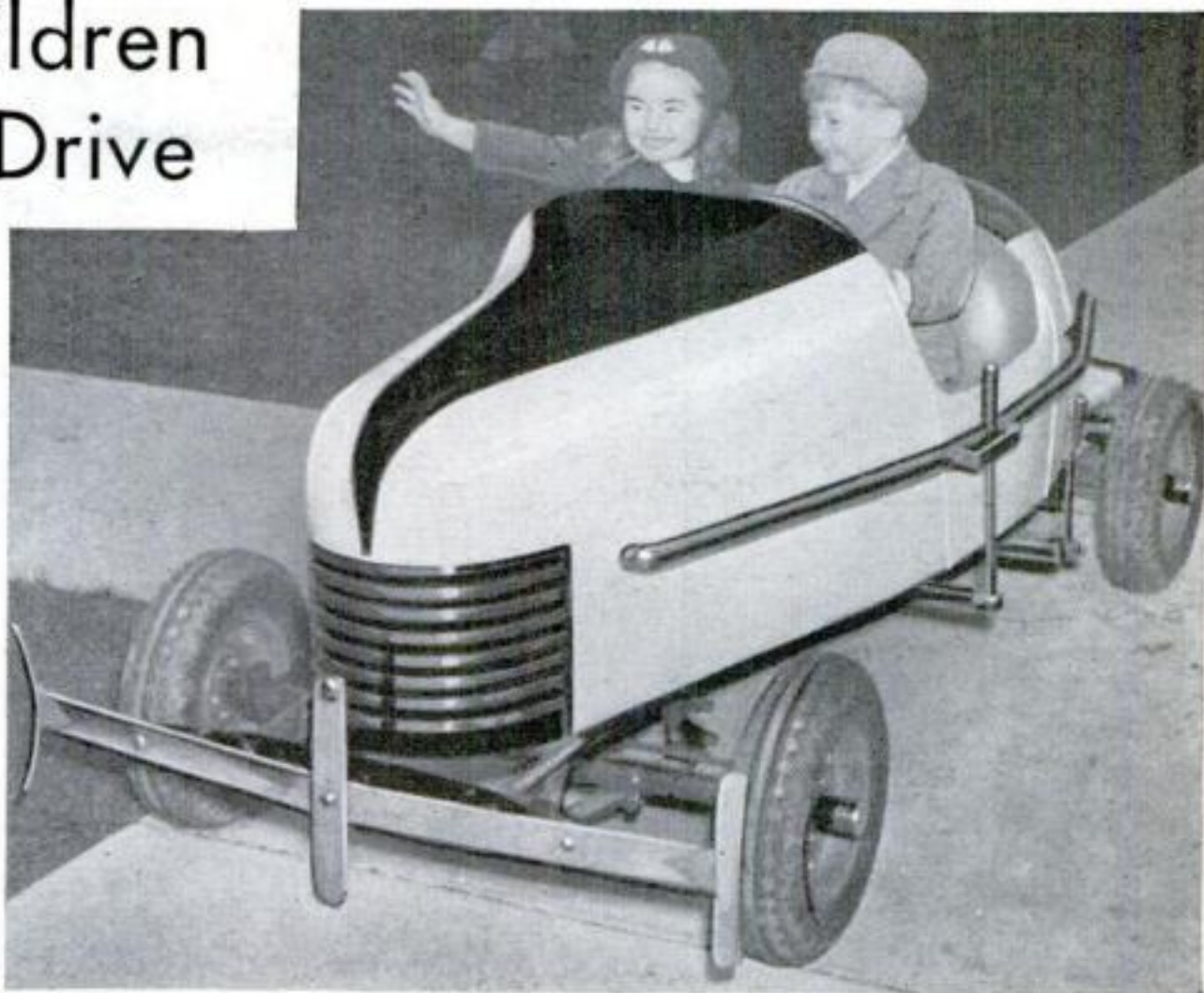
SEALED-BEAM lights can now be installed on cars a year or more old with the parts contained in a new headlight conversion kit. The change-over is said to be extremely simple. It merely is necessary to remove the rim, lens, and reflector from your present headlamp, install the new parts contained in the kit, make several wiring connections, and replace the headlamp rim. Adjustments are provided for aiming the lamps properly. Two types of kits are available, adaptable to most standard makes of cars and trucks.



Parts like those shown above and at left fit sealed-beam lights to the headlamps of your car in a few minutes

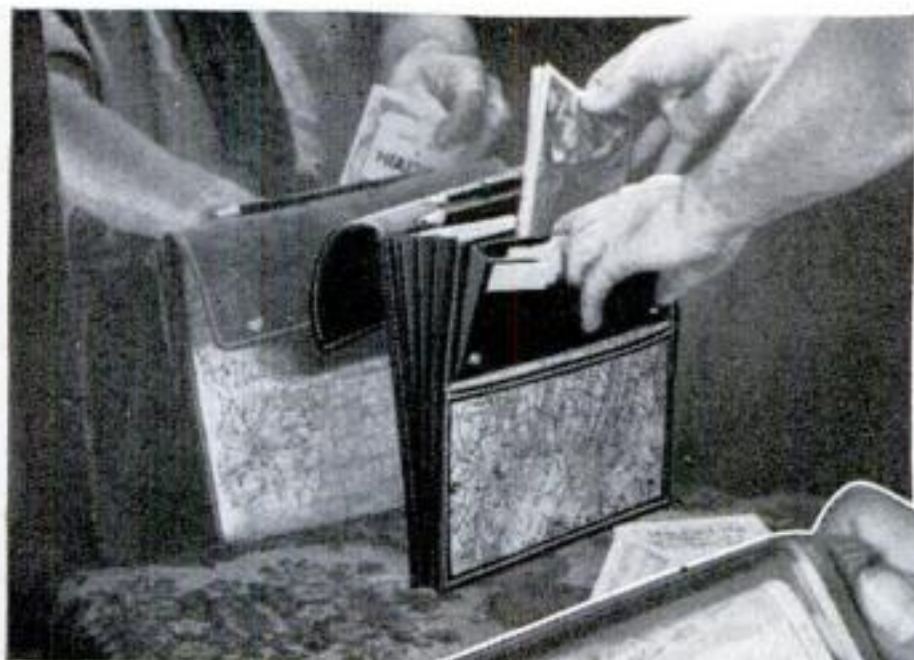
Car for Children Is Easy To Drive

DESIGNED and built by Karl Newhold, of Roseville, Mich., an automobile for children has an all-steel, racing-type body mounted on a sixty-four-inch wheel-base. The diminutive car is powered by a 2½-horsepower gasoline engine that drives the midget at a top speed of twenty-five miles an hour. Simplified controls consist of a steering wheel and a combination lever that operates not only the starter, but the brakes and clutch as well.



Out for a spin in the kiddies' car. It can do twenty-five miles an hour.

Three Map-Reading Aids for Tourists



THREE new aids to help motorists follow their touring routes easily have just reached the market. Shown at the top left is a map case with transparent pockets on the front and the back for maps in immediate use, plus three pockets for extra maps, and pencil-holding loops. Below this is pictured another map case in which any map six and a half inches wide and under twenty-five feet long may be mounted on rollers and turned by knobs to bring a desired section into view below the transparent cover. The third item is a key chain and ring fitted with an unbreakable plastic magnifying glass to simplify the task of examining road maps in detail.



At top is a map case with transparent side pockets. Above, another case in which strip maps move on rollers under a window. Right, key chain with unbreakable magnifying lens



CAR TIPS FOR

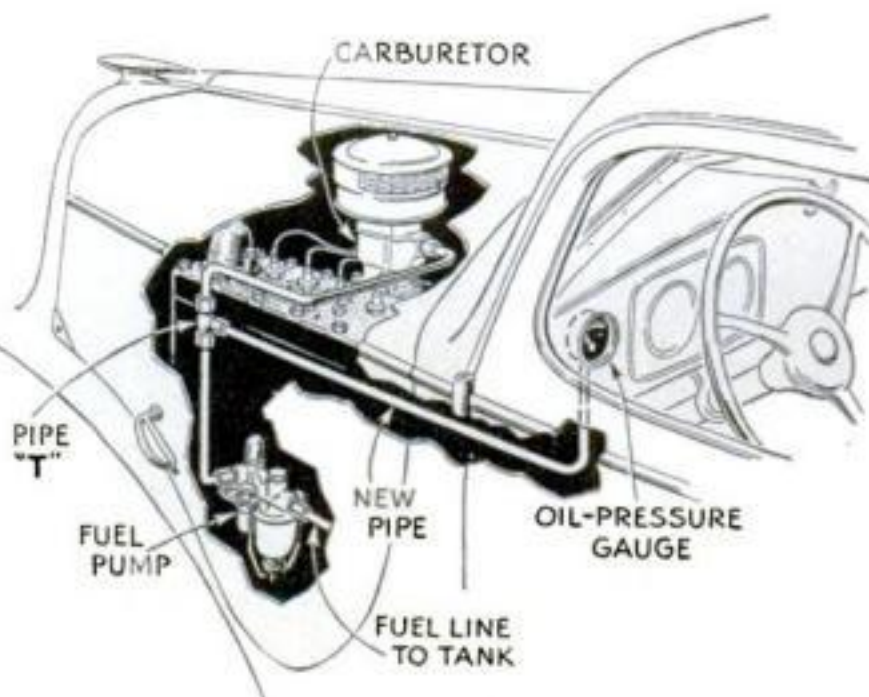
Reflector Button Inside Door Protects Motorist

FOR car repairs beside the road at night, it is a good safety measure to have a red reflector button fastened permanently on the inside of the left front door, or of either left door hinged at its front edge, as indicated in the accompanying sketch. If your doors are hinged at their rear edges, have a button on hand that can be hung on a door handle when needed. Motorists coming from behind when the door is open will see the reflector and be warned in time to give you and your car a wide berth.—R. H. P.

Other cars' lights illuminate the reflector

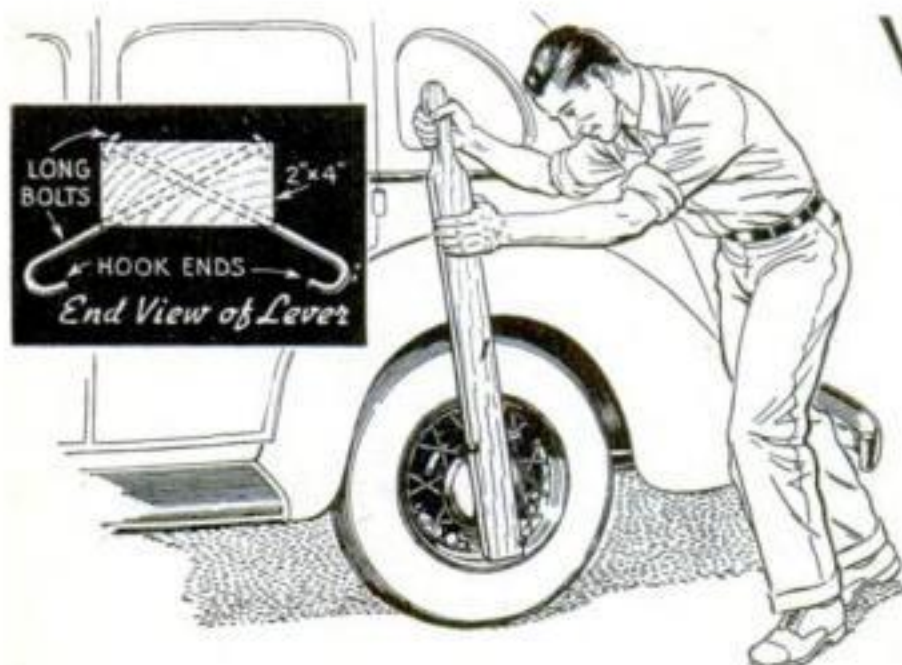
Easily Made Gauge Tells Fuel-Pump Condition

A GASOLINE-PRESSURE gauge to show that your fuel pump is working can be made from a length of copper tubing, a pipe T, and an old low-pressure oil gauge. The T is inserted in the line between the pump and the carburetor, and a new line run to the gauge mounted on the dash. For rubber-mounted engines, insert a flexible pipe to absorb vibration.—R. McC.



Wheel Lever Aids Moving of Cars in Garage

Two long bolts inserted in a four-foot length of two-by-four, as shown at the left, and hooked over at their ends, provide a highly useful wheel lever for moving cars about in a garage. In use, the hooks are inserted in the spokes or slots of a rear wheel, and the handle pushed in the direction it is desired to move the car. One man can thus move a car easily. Rubber tubing pushed over the bolts will prevent marring the wheel finish.—E. H.

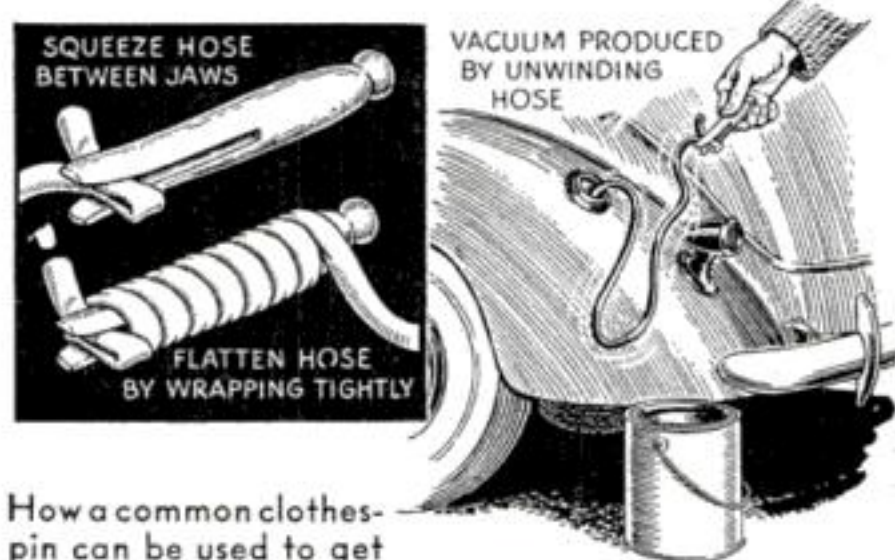
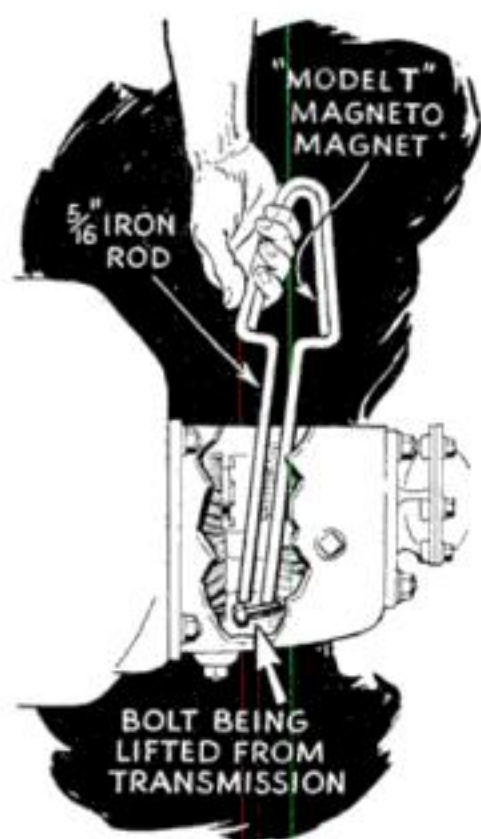


AMATEUR MECHANICS

Long Magnet Recovers Dropped Parts

MANY mechanics have had the time-wasting experience of losing a key, washer, or nut in a transmission box or other out-of-the-way place in a car. A long-reach magnet will get them out in a hurry. I made one from an old Model T magneto magnet, around which I

shaped a length of 5/16" iron rod as shown, leaving parallel extensions about a foot long and an inch apart. The assembly should be seasoned for about twenty-four hours before attempting to use it, to become thoroughly magnetized.—R. S.



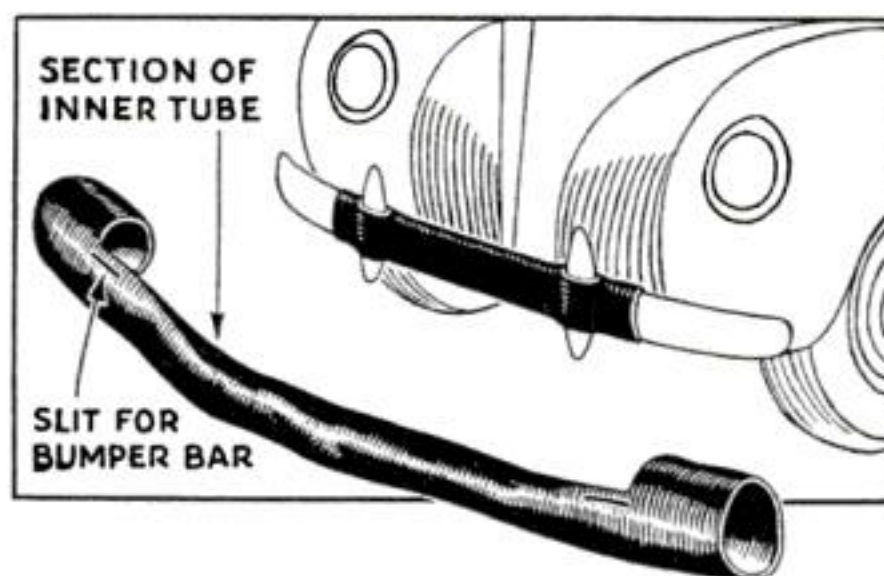
How a common clothespin can be used to get siphon action started

Clothespin Starts Siphon

YOU can use a clothespin to start siphoning gasoline from a car tank, avoiding the danger of sucking poisonous chemicals into your mouth. Pinch one end of a rubber tube between the jaws of the pin, and wrap the tube tightly over the whole pin. Place the other end in the liquid and unwind the tube. It will quickly fill with gas.—L. W.

Rubber Bumper Protector Is Old Inner Tube

BY CUTTING a length of old inner tube in the manner shown in the illustration at the right, you can make an effective bumper protector for your car. Folded and stored under or beside the spare wheel in your luggage trunk, it will always be available for slipping on the bumper when you are called on to push a friend's car with your own. You will find that it will protect the finish of both your bumper and his from ugly scratches.—E. H.



This pattern will make a guard for most car bumpers

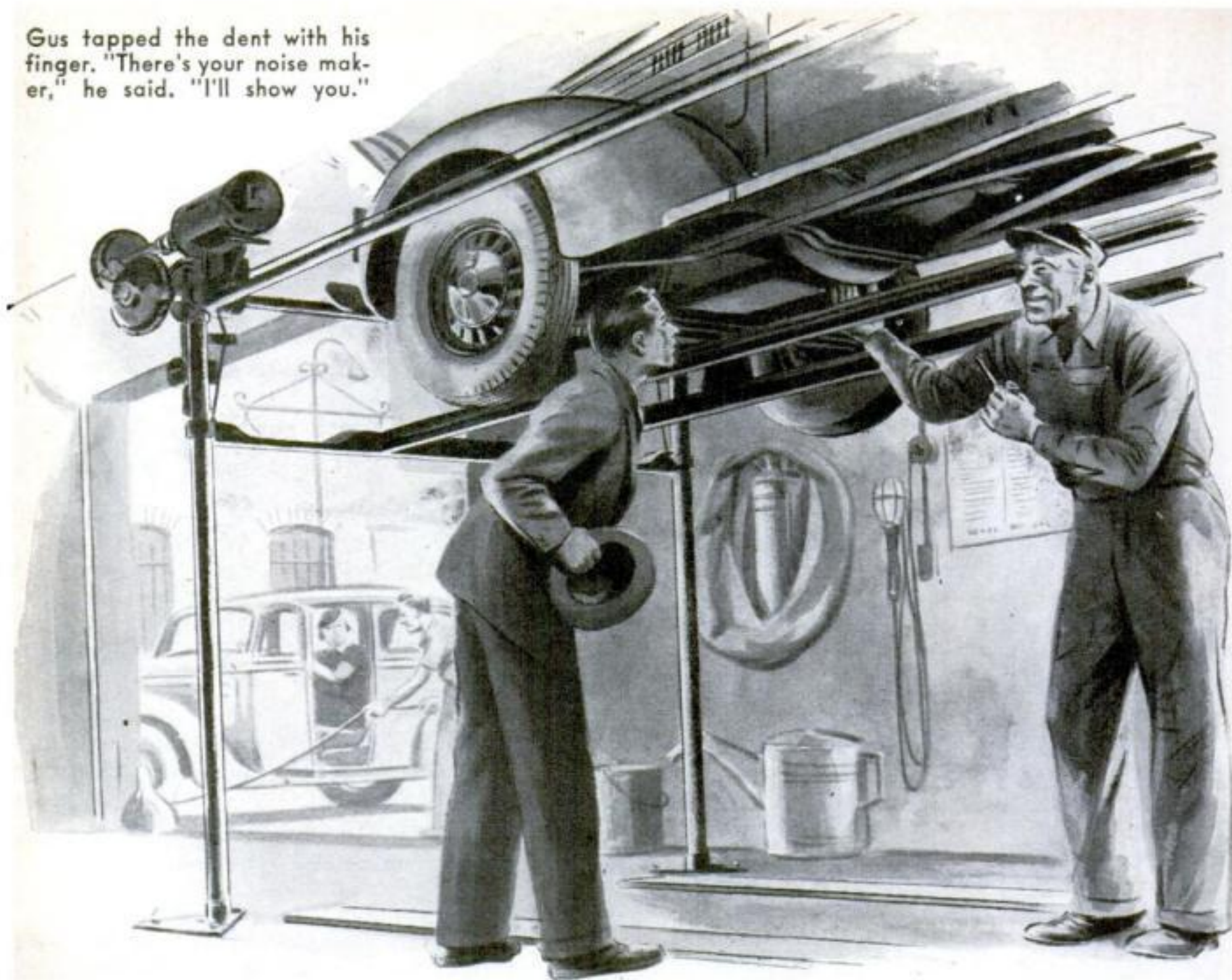
Grease Saves Fender Finish

WHENEVER I have to straighten out a banged-up fender that is not too badly mashed, particularly where the finish has not been chipped when the damage was done, I smear heavy cup grease on the outside of the fender. Then I go to work and hammer the metal back in shape in the usual way. I have found that when the fender is not too sharply dented, a refinishing job is seldom necessary after the greasing precaution has been taken, as the enamel is kept from cracking away from the metal by the heavy-bodied material.—D. M.



Greasing the surface to keep paint from chipping off

Gus tapped the dent with his finger. "There's your noise maker," he said. "I'll show you."



Gus Listens, Then Looks

THE tan-colored roadster on the Model Garage's greasing rack was five years old and it wasn't of an expensive make, but Gus Wilson nodded satisfaction when he looked at it. Then he turned to the brisk-looking young man who had brought the job in.

"That's the way I like to see a car kept," he observed. "Shows that its owner has had sense enough to learn something about the machine he's driving, and that he isn't afraid of getting a little oil and grease on his hands. Without even stepping on the starter, I'm willing to bet you get good mileage out of the gas you burn, and that your engine does its job without making a lot of noise about it."

The young man laughed bitterly. "You'd win on the gas end of your bet," he said, "but you'd lose on the noise end. That engine *does* make a noise—a queer sort of noise that I've spent a lot of hours and quite a few dollars trying to kill. But I've

never been able to even locate it, let alone kill it. It's annoying, but it doesn't affect the car's performance."

"That so?" Gus said, immediately interested. "How come?"

"I bought the bus when it was three years old, and had about thirty thousand on its clock. I had new piston rings installed, spent several evenings getting everything else in first-class condition, and then started off on a two-week vacation trip. The first hundred miles or so were swell—no trouble at all. Then I began to hear that noise—a light tapping. It sounded to me like a valve stem chattering in its guide, or maybe a broken ring. I got out and looked things over as thoroughly as I could on the road, but didn't find anything wrong. So I went on. So did the noise! But the car continued to run all right.

"That evening I checked things more thoroughly, but I couldn't find a thing wrong. Next morning it was the same as

it had been the day before—not a sound for a couple of hours, and then that tapping again. It was like that every day for two weeks, and it darned near ruined my vacation.

"As soon as I got home I had the car gone over by the people who had installed the new rings. They said that the noise was caused by the push rods, which were worn and should be replaced. So I had them put in new push rods. Same thing all over again—I'd start out all right, but after I'd been driving a couple of hours the tapping would start.

"Since then I've had the car in a dozen shops, but no one has been able to find the cause of that noise. Now I've given up looking for it. But at that it still bothers me."

"Sure—it would," Gus sympathized. "You never hear it until you've been driving a couple of hours, hey? That looks as if—"

He broke off, went over to the car, walked under the greasing rack, and ran a forefinger over a small dent in the lower flywheel cover. "That's been there ever since before I bought the bus," the owner told him. "The first fellow who had her must have dented it driving in a deep rut—or maybe a heavy rock hit the cover."

Gus nodded. "That noise you were telling me about," he said. "Is it any louder when you're doing fifty than it is when you're going about thirty?"

"Not much louder," the young man said. "But the taps seem to be a lot faster when I'm going fast. At fifty the noise sounds continuous."

Gus tapped the dent with his finger. "There's your noise maker," he said. "I'll show you. . . . Hey, Harry, get that lower flywheel cover off, will you?"

His helper took the cover off. Gus examined its inside surface carefully. Then he pointed to a small burr, on which the metal was polished bright by friction. "There it is," he said. "A tooth on the flywheel starter ring that's maybe only a couple of thousandths of an inch higher than the others just barely touches that burr on every revolution of the wheel. I suspected something like that when you told me that the taps are closer together when you are going fast than they are when you are going slow. A noise like that

When It Comes to Curing Car Ills You Can Save Your Hands by Using Your Ears and Eyes

• • •
By MARTIN BUNN

always is hard to locate—it gets magnified, and by the time it gets out to you it might be coming from anywhere in the engine. Want me to fix it? Flattening out the burr and putting a little weld in the cover will do the trick."

"There's something I don't understand," the young man hesitated. "Why is it that I never hear the noise until I've driven a hundred miles or so?"

"Expansion," Gus told him. "That burr isn't high enough for that high tooth to hit it while the engine is fairly cool. But after a couple of hours of driving the engine gets good and hot. That causes the metal of the flywheel to expand—and that makes the high tooth hit the burr."

The roadster's owner still looked doubtful. "I know—you've been stuck before on this job," Gus said. "This time you needn't take a chance. If you ever hear that noise again, drive in here and I'll give you back your money."

"Go ahead and fix it," the young man said.

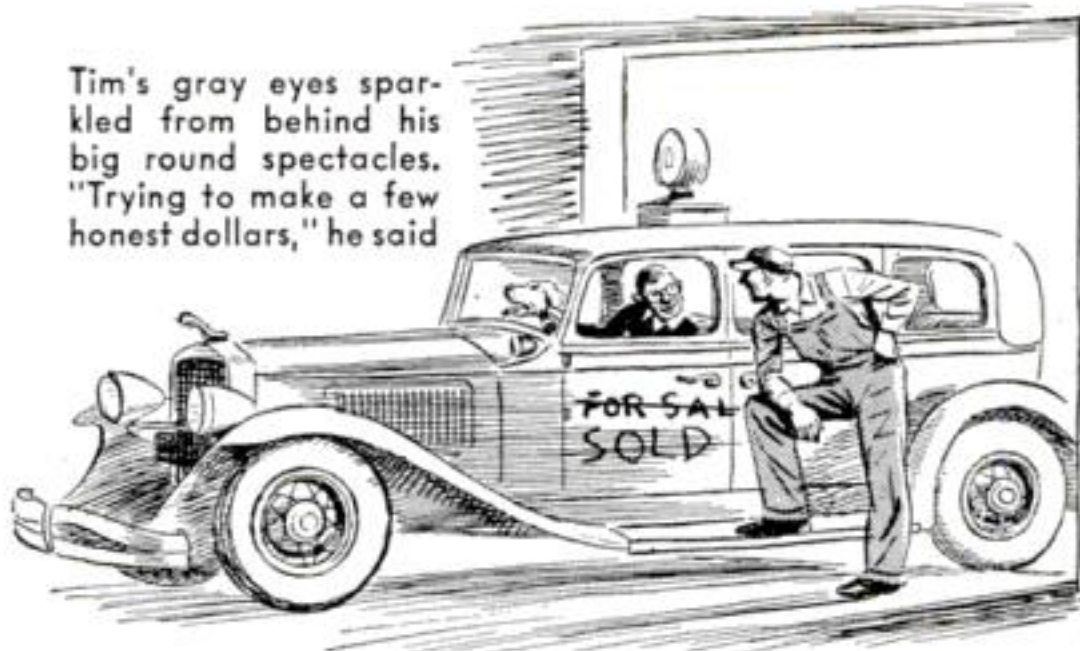
An hour later, tousle-headed young Tim Sheridan, his dog, Dodger, on the seat beside him, drove into the shop in a sedan of '32 vintage and disreputable appearance.

"What the heck are you up to now?" Gus greeted his favorite disciple.

Tim's gray eyes sparkled from behind his big round spectacles. "Trying to make a few honest dollars," he said. "I bought this old wreck for fifty, and I've dug up a guy who'll give me a hundred for it—if I can make it run right. That fifty-dollar profit is exactly how much more I need to get me through my first year at Tech."

"That close? Good for you!" There was appreciation in Gus's voice. He knows how

Tim's gray eyes sparkled from behind his big round spectacles. "Trying to make a few honest dollars," he said



hard Tim has worked getting together the stake which will put him on the road to being able to sign "M.E." after his name. "Well, what's the matter with the bus—senile decay?"

"I don't know what's the matter with it," Tim admitted. "What *was* the matter with it was that it was so full of carbon that it knocked whenever it tried to climb a hill. I've scraped the carbon out, and ground the valves. But now it dies on me whenever I speed up the engine. It'll keep going, after a fashion, with the choke all the way out, but when I put it in—dead!"

"Carburetor all right?" Gus asked.

"Yes. I cleaned it, and adjusted it. Gas line, too."

"How about the valve clearances?"

"Exactly what the book calls for."

"Then it may be the fuel pump," Gus suggested.

"That's what I thought. But it isn't the fuel pump. I put in new diaphragms. Didn't do any good."

"Yes?" Gus said. "Let's have a look."

He examined the pump and carburetor. "Start your engine, and let it idle," he told Tim. The engine idled smoothly enough. "Huh!" Gus grunted. "Now speed her up." Almost at once, the accelerated engine stopped.

Gus felt the nut where the gas line connected with the pump to make sure it was tight. "What's this?" he demanded. He held up his hand, his thumb and forefinger were covered with some sticky substance.

"Shellac," Tim said. "I put some around the line nut to make sure it wouldn't leak."

"You did, hey?" Gus grumbled. Deftly, he dismantled the fuel pump. Then he carefully examined the check valve. "Take a look at this. See? The valve is gummed to its seat. Some of your shellac worked back into the valve seat. Clean it out thoroughly, and put in a new check valve."

Tim examined the valve intently. "You're right—as usual," he admitted. "The valve's stuck sort of half way—open enough to let sufficient gas flow through to keep the engine idling, but not enough to keep it running when you step on it."

It was quitting time, and Gus began to wash up. Tim perched on the workbench and rolled a cigarette. "You're a good guy, Gus," he said. "I sure do need that fifty dollars, and now I'll get it."

"Forget it," Gus growled. "Anyhow, I like trouble shooting. Keeps the old bean in working order. Did I ever tell you about the hardest trouble-shooting job I ever ran up against? It was four or five years ago. An ice-cream company down in the city bought a fleet of sedan delivery cars and outfitted them with dry-ice refrigerators. Before long, they began to find the cars' transmissions dry when they inspected them, and the grease in the differential housing instead of where it belonged. The manufacturer's service man

told them to pack the rear-bearing lock-ring slots with ground cork—but that didn't do any good, and neither did anything else that they tried.

"The fellow who has charge of their garage is an old pal of mine, and when his boss began giving him real hell he called me up and asked me to go down and see if I could find the trouble.

"They were having exactly the same grief with all their cars, so I worked on only one of them. I took its transmission down, and checked every part—O.K. I checked the alignment with the rear end—O.K. I did everything I could think of, and every night the car came in with its transmission almost dry and the grease in the differential housing.

"I began to lose sleep over the job—and I hate to lose sleep. One day I got down to their garage just as the car I had been working on was driven in. I got under it, and as I took out the plug to check the grease I heard a peculiar sort of hissing sound. That was the tip-off. Without saying anything to anyone, I took a small electric hand drill and drilled a very small hole in the torque tube.

"I was waiting when the car came in the next day, and I got under it in a hurry. The grease was all in the transmission, where it belonged, and I knew I had the trouble licked."

"All right," Tim said. "I'll bite. What *was* the trouble?"

Gus grinned. "The ring and pinion gears created a suction which pulled the grease down the torque tube into the differential," he explained. "The hole I drilled killed the suction. In the next year's model the makers vented all their torque tubes. One of those little things—easy to fix, but the hardest trouble-shooting job I've ever been up against."

GUS SAYS:

Somebody tried to tell me that car headlights are too bright nowadays. That's as foolish as saying modern gas is too strong, cars too fast, roads too good. Remember this. They're all just as safe or dangerous as the car drivers that use them!

THE HOME WORKSHOP



GEORGE
GIGARE

In This Issue... SHOP LAYOUTS • DIVING GOGGLES
ACTION PHOTOS • BOOMERANGS • PAINTING

How to Lay Out

FIG. 1

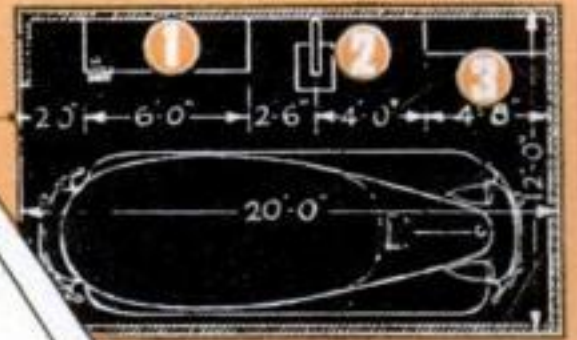


FIG. 2

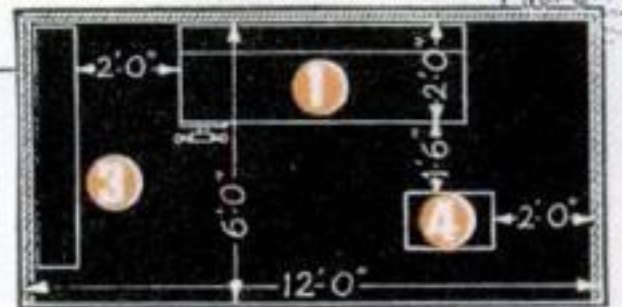
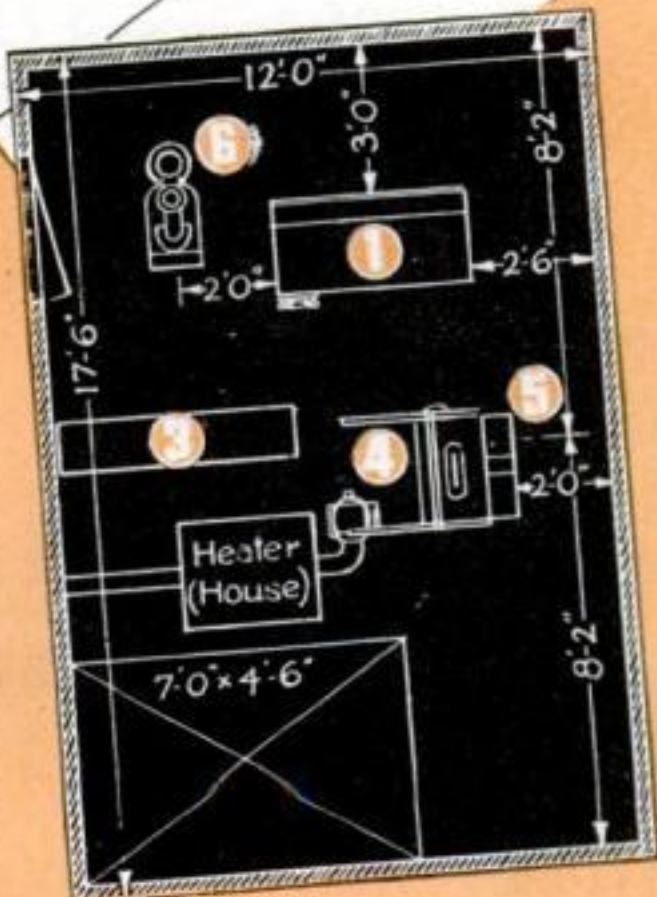


FIG. 3

STORAGE SPACE



Key

- 1 WORKBENCH
- 2 SCROLL SAW
- 3 LATHE

- 4 CIRCULAR-SAW TABLE
- 5 JOINTER
- 6 DRILL PRESS
- 7 RADIAL SAW

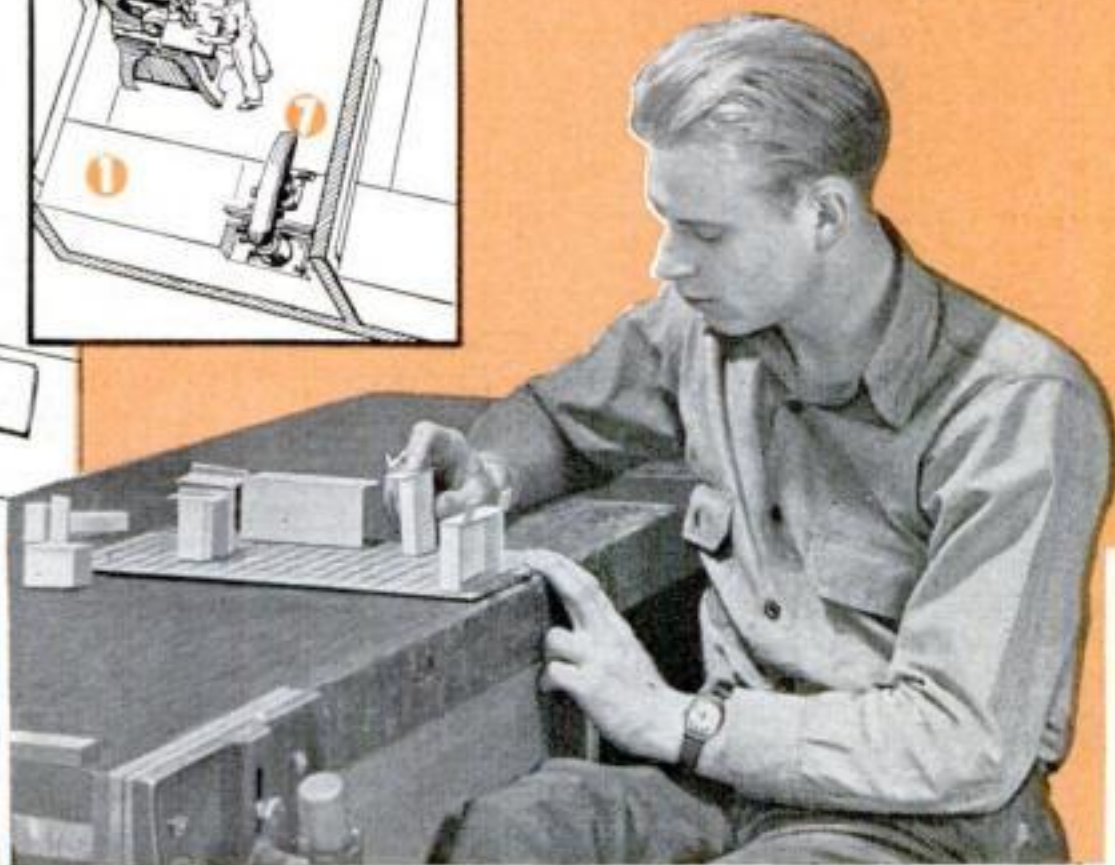
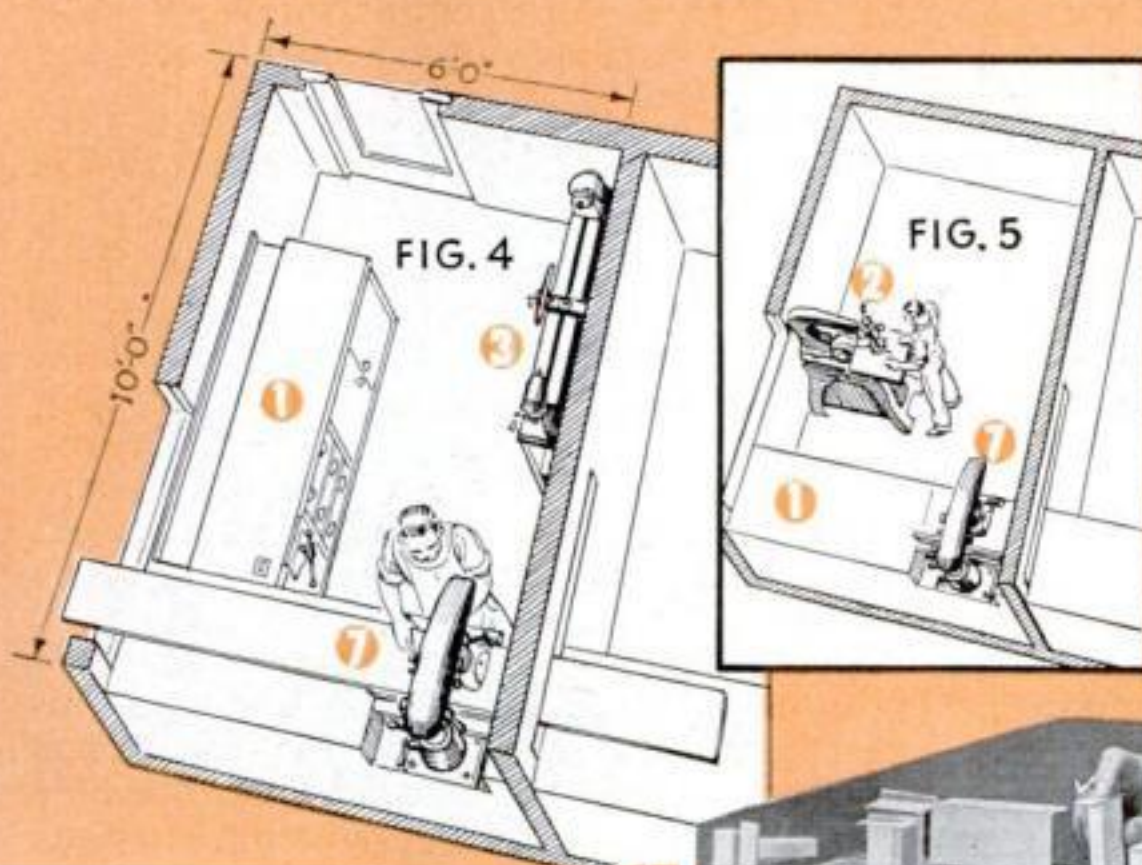
LIKE Robinson Crusoe on his lonely island, one machine in a shop is a law unto itself. If it is a circular saw, for instance, it may be the center for all other equipment. But let a shaper or a band saw be added, and the situation is changed, for machines, like men, have personality. Each prefers a certain task; each works best in its proper surroundings and with suitable companionship.

A jointer or a circular saw, to handle long pieces of lumber, demands a large working clearance in front or behind. A large room, of course, satisfies this need. In the usual small home shop, however, this space must be found by passing lengthy boards over benches and low machines, or by locating the machine near

Your Home Workshop

By EDWIN M. LOVE

Left, two suggestions for workshop layouts in a lean-to built on the back of a garage. Note slit in the wall for long lumber



a door or a window, through which stock may be thrust for feeding or removing.

A lathe, for most work, requires only to stand against a wall. Other power tools usually need but two feet of space in front and at the sides. It is evident, therefore, that the placing of a machine depends not only on accessibility, but also on the size and shape of the room, the other machines, and the type of work to be done.

The personality of the user also must be considered. The most convenient placing of equipment is often not the neatest, and if the owner is bothered by a lack of order and is oppressed by the feeling of restriction occasioned by irregular spotting of machines, he may find it best to arrange them according to appearance rather than their most efficient use.

This article suggests several arrangements for small shops equipped with from two to four individually driven woodworking machines. There is also a diagram of a fully-equipped shop, such as a home workshop club might own. It must be emphasized that these are only suggestions, intended to help in placing accessories to the best advantage in the room the owner has available. Later articles will deal not only with the groupings of several machines, but also the use of line shafts, gasoline-engine drives, and special model-making layouts.

The best way to plan your shop is to make rough models of the machines and move them about on a scaled layout of the floor space

These diagrams show no cabinets. Shouldn't they be considered in a shop plan?

It is the writer's conviction, as a result of much experience, that most accessories and hardware materials can be stored in cabinets under the machines and benches, and hand tools and lumber placed in racks on the wall or in hanging cupboards. Floor space is precious, so why build skeleton benches and mount machines on open stands, and then build floor cabinets to clutter up the room? Arrange the machines first, and adapt storage space to them. Cabinets and similar equipment will be fully considered in later articles.

Could a shop be started in a single garage?

If the garage is 12' by 20', as many are, it is possible to obtain a working space about 5' wide by driving the car close to one side. This is rather narrow and limits the number and kind of machines that can be chosen, but it is much better than nothing.

Considering everything, the layout suggested in Fig. 1 is quite satisfactory. The

bench indicated is 6' long, with cupboard room inside and a good working space at the vise end. With the scroll saw adjusted for cutting from the side, not only can small lumber be handled, but long decorative bands or cut-outs as well.

The lathe is chosen because turning cannot be done by hand, or even imitated without prohibitive labor. If outboard turning is to be done, the machine is easily swiveled to a diagonal position.

How can end space in the garage be utilized?

Figure 2 is a good plan for a shop at the end of the garage. If a side door is present or can be cut in, set the circular saw near it, where long boards can be fed in. The saw, if equipped with rollers, can be pushed back at the end of the bench if the car encroaches. In this shop, moldings on straight work and outside curves are possible, but sawed curves and fretwork must be done by hand.

Must benches, and machines other than the circular saw, be placed against the walls?

No. Some of the best arrangements come from putting the ends to the wall, or even

by standing equipment entirely out in the room, as in Fig. 3. This plan is excellent for irregular layouts, as in a basement. Notice that the drill press, lathe, and circular saw are within a radius of about 3' from the bench vise. A scroll saw could stand along the back of the bench within the same circle. All machines are within a couple of steps from the bench.

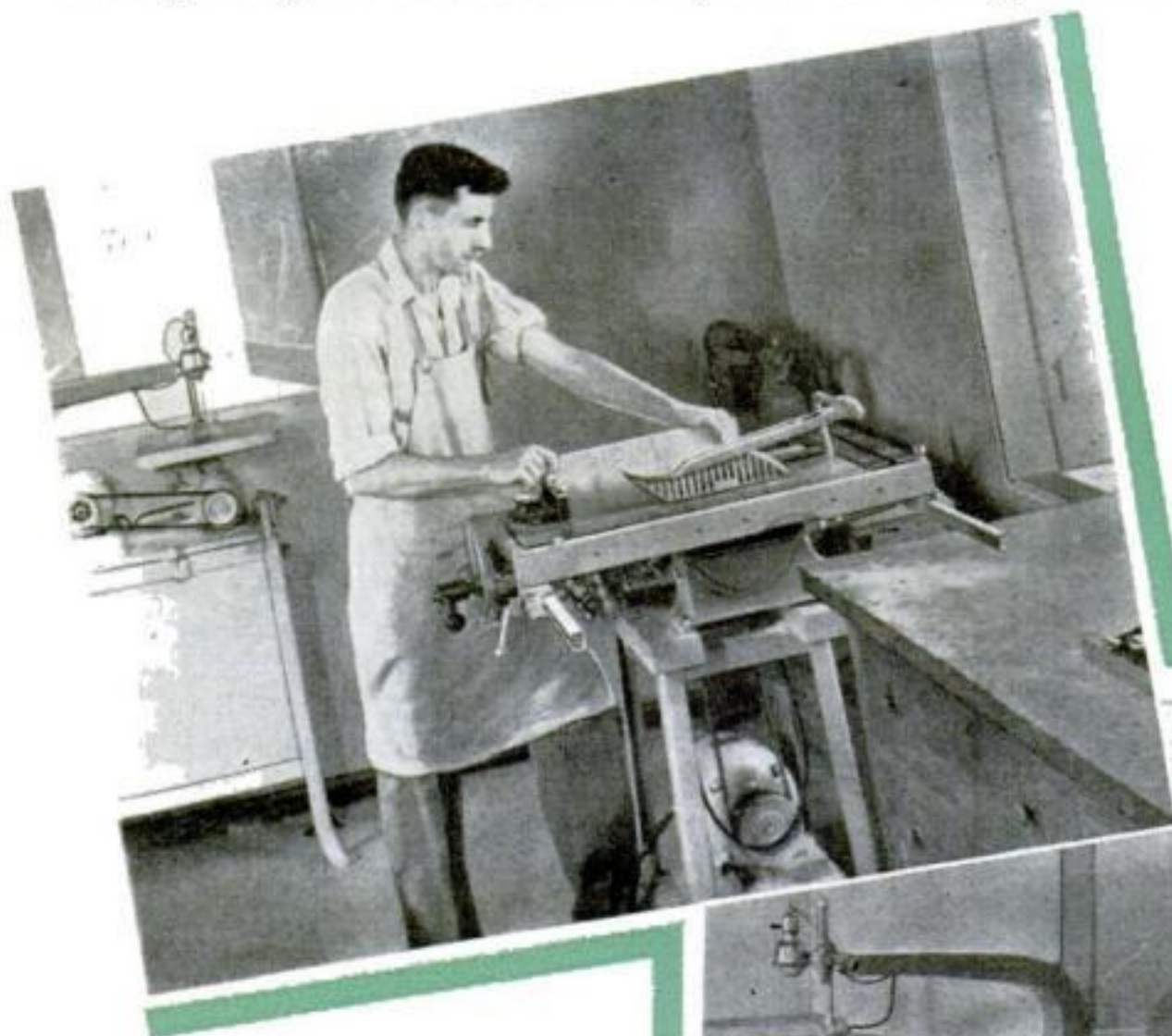
How may a small lean-to or other addition to a garage be made into a shop?

The plans in Figs. 1 and 2 would fit. Figure 4 is an ingenious arrangement for an addition built on the end of a garage 10' wide. Although the room is but 6' wide, long boards can be crosscut or ripped by the use of a circular saw of the overhead-track variety mounted on a bench at one end. A slit in the garage end and a large window opposite will allow stock up to 4' wide to pass. A supporting bench is built in the garage.

In Fig. 5, the bench and lathe are replaced with a scroll saw, the saw bench serving as a workbench and cabinet. Machine crosscutting and ripping, jointing, shaping, disk sanding, grinding, scroll sawing, edge filing, die filing, and metal sawing are possible in this shop.

Should the first machines be arranged in the order they would take in a complete shop?

Not necessarily. It is better to stand them where they will work to the best advantage. As more units are added, the work of certain machines may become more specialized and they will be less frequently



Saw and jointer combination is near a window, lathe is out of way but available for most work, scroll saw is by second window

A three-in-line plan. Longer boards can be passed over scroll-saw table by raising blade guide. Other end of lumber extends over a lathe



used, so it may be better to shift them to a less desirable position. Nevertheless, the arrangement of the complete shop should be planned at the start so that windows, doors, and electrical outlets can be intelligently placed for that purpose. Minor deviations in the original plan can always be made if necessary.

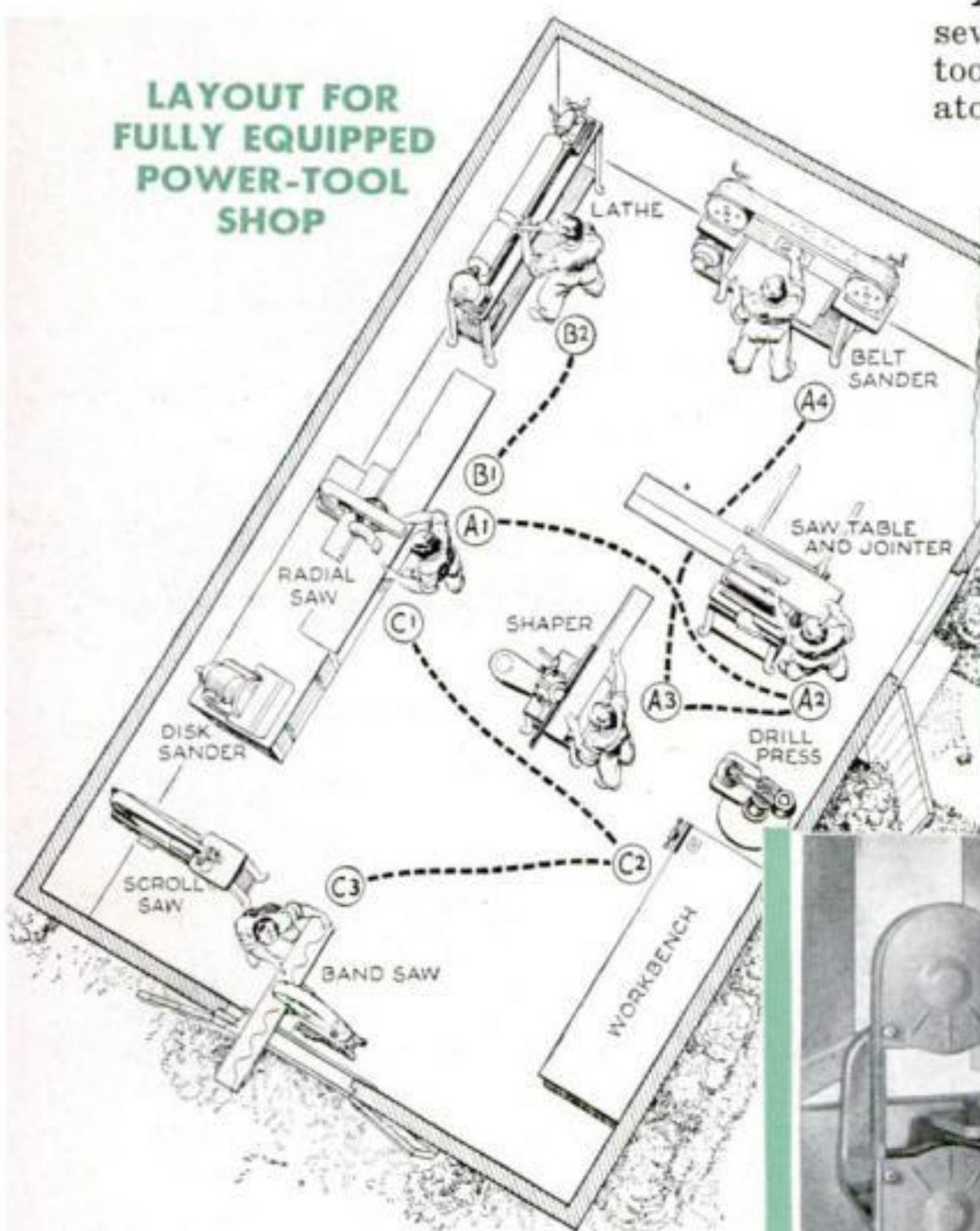
What about the arrangement of a commercial shop or one for a home workshop club?

Always arrange the machines to save as many steps as possible. In the mass production of an article, the machines needed should be close together. Step saving is clearly shown in the diagram on this page.

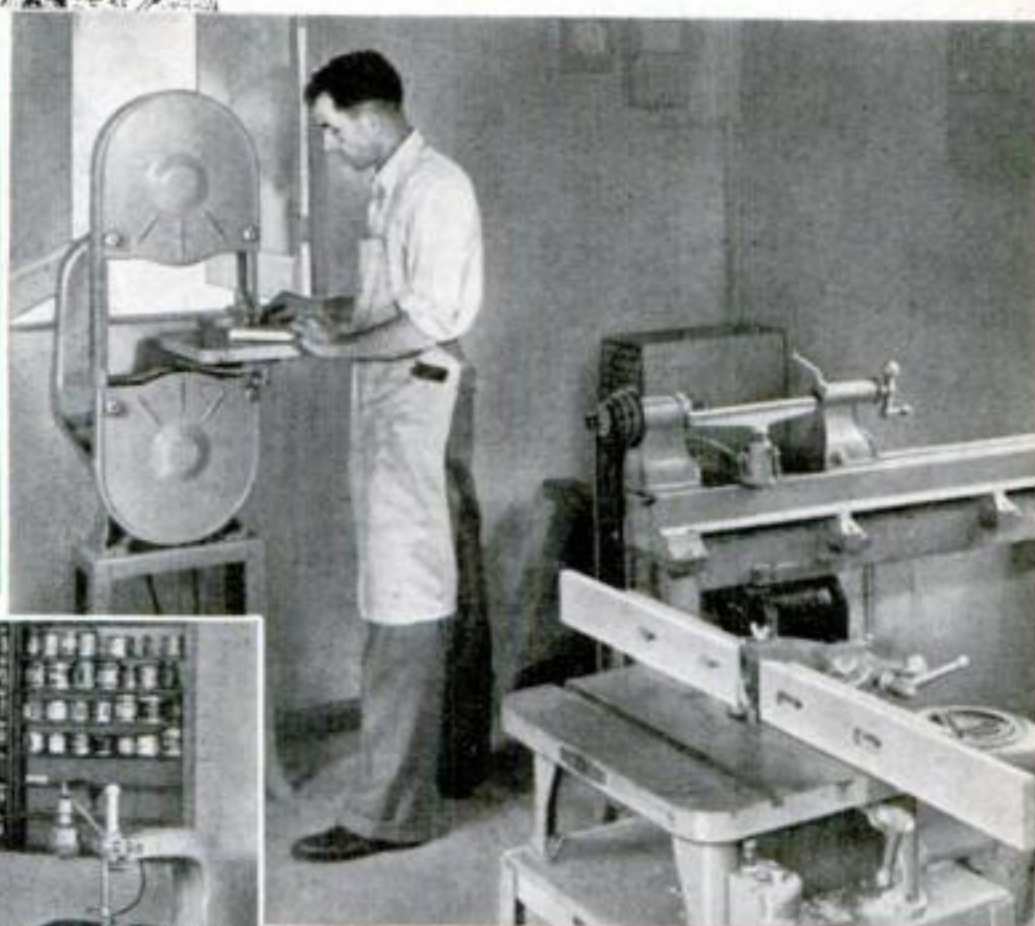
Another point to keep in mind is that if several men are working at once, the power tools should be so arranged that the operators do not get in one another's way.

(TO BE CONTINUED)

LAYOUT FOR FULLY EQUIPPED POWER-TOOL SHOP



When planning a well-equipped shop, such as for a home workshop club, arrange the layout in advance as a guide for placing electric outlets and other facilities. The one at left is for a room 12' by 20'. Note how this layout saves steps. For example: A-1, operator cuts board off; A-2, rips and joints it; A-3, shapes molding; A-4, sands it. For a turned project: B-1, he cuts stock to length; B-2, turns it. For band-sawed work: C-1, he cuts stock to length; C-2, lays out pattern; C-3, band-saws it



In this arrangement band saw is by window, lathe can be used at front or end, and shaper can handle fairly long stock. A good grouping to follow when the space is restricted

At left, handy layout for a small shop having workbench and two power tools. Note economy of steps. Window is not needed next to machines

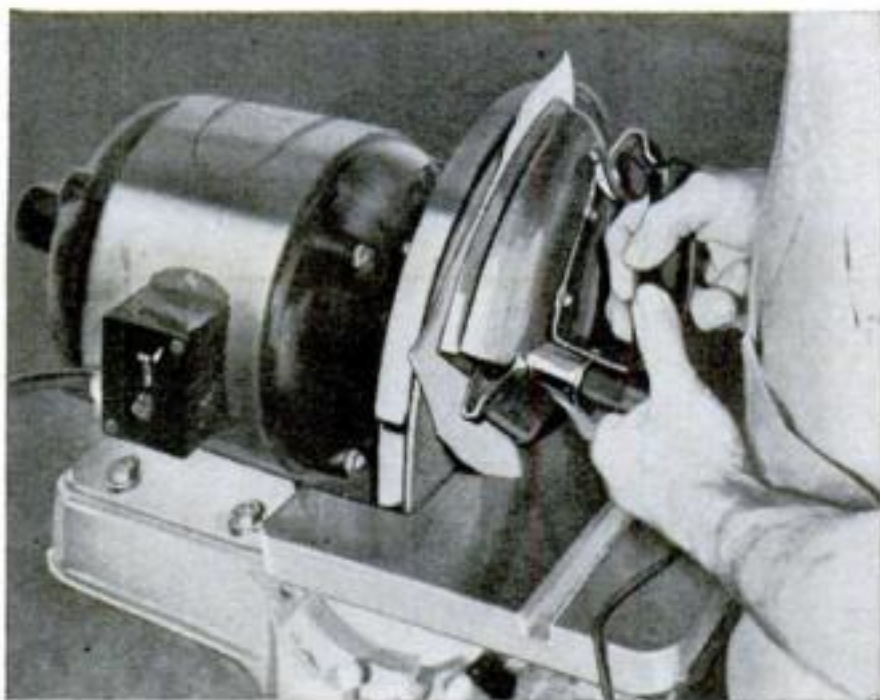


Two-Ply Baseboard Bends to Fit Curved Wall

BENDING baseboards to fit curved walls can be done readily if two or more thin layers are used, as illustrated above. Apply them to the wall separately. Fasten the inner layer or layers with screws, and the outer one with finishing nails. If the bend is sharp enough to require it, screws can also be used at the bottom of the outer layer where they will be concealed by the floor molding.—JOHN MODROCH.

Electric Iron Smooths Sanding Disks

STICK adhesive applied to sanding disks is likely to produce an uneven coat, especially if the metal is cold. After putting the sandpaper disk in place, cover it with a sheet of wrapping paper and press it with a fairly warm electric flatiron. The disk will adhere quickly, and all lumps of adhesive will be leveled off.—LESLIE KINNING.

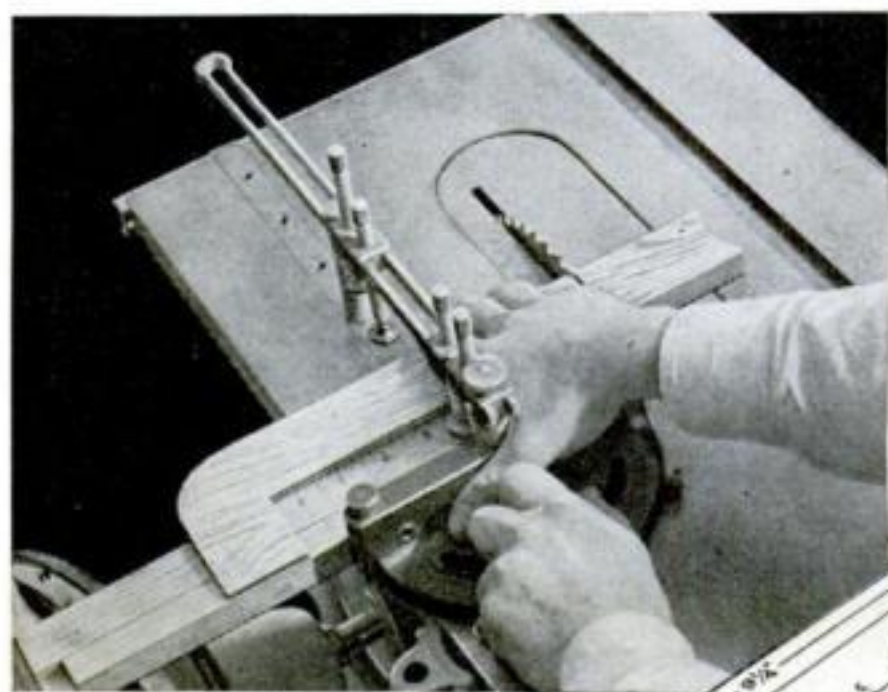


The disk of sandpaper is covered with wrapping paper and pressed with a fairly warm electric iron

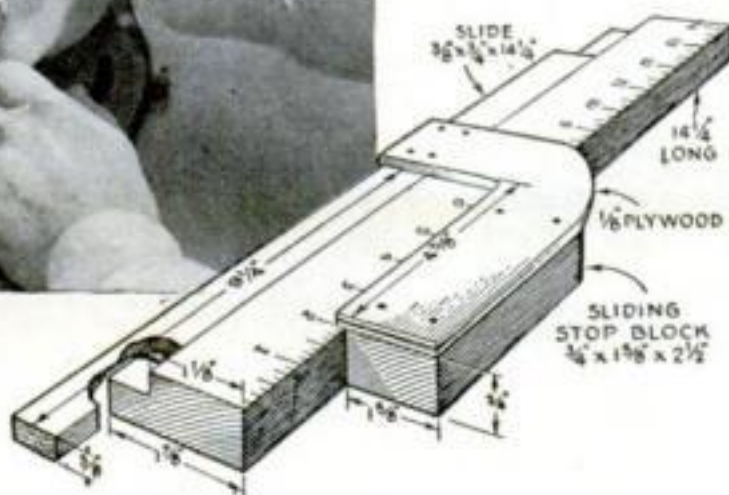
Using Blowtorch Near Woodwork

WHEN it is necessary to use a blowtorch on plumbing near beams, flooring, or other woodwork, a quantity of wet powdered asbestos may be placed on the area where the flame might reach to prevent a fire hazard.

Adjustable Cut-Off Gauge Added to Circular Saw



Made as shown at the right, the gauge is held with the regular miter-gauge clamping attachment of the saw



IF THE miter gauge of your circular saw is equipped with a clamping attachment, you will find it easy to cut small pieces of wood to exact size with the aid of this adjustable stop. In the original, the measurements on top of the body piece were scribed in and afterward inked, but a short rule may be let into the wood and will serve as well.

Dimensions of the original attachment are given at the left.

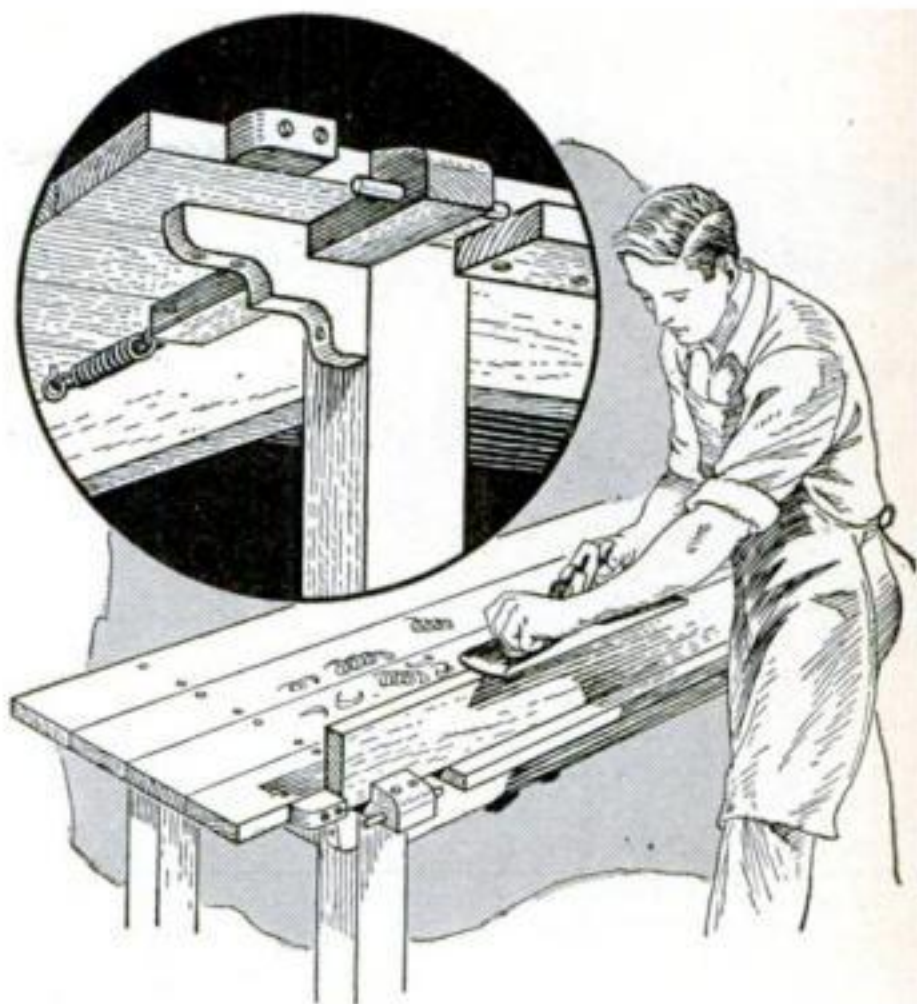
In use, the jig is slipped under two of the clamping screws, and the right edge of the body section is brought just up to the saw teeth and clamped. The sliding stop block is then set at any point desired and clamped.—G. H. S.

Planing Vise Adjusts Itself to Any Wood

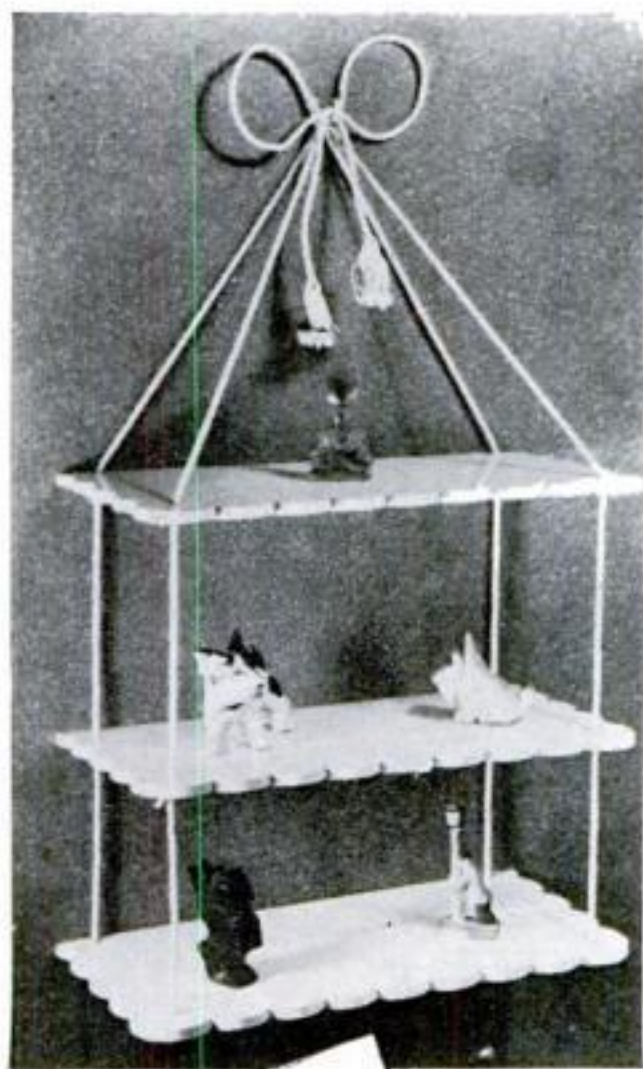
FOR planing the edges of different thicknesses of wood, ranging from very thin up to 2", I have for years used the quick-acting vise shown at the right. It can be made small for model work or larger for general work. One great advantage is that it does not obstruct the surface of the workbench as is the case with the V-type planing stop so often used. A powerful spring is required. The one on my vise was taken from an old iron bed.—ABBOTT B. DAVIS.

• • •

IN LAYING out accurate measurements on wood, it is best to make the marks with a knife or a rather hard, sharply pointed pencil. If the rule is old and worn, measure from the 1" mark rather than the very end.



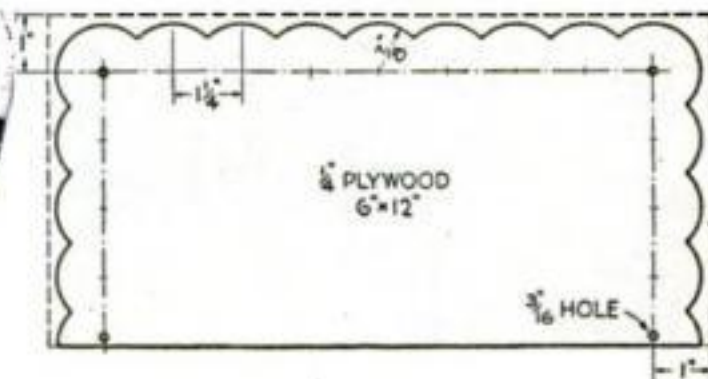
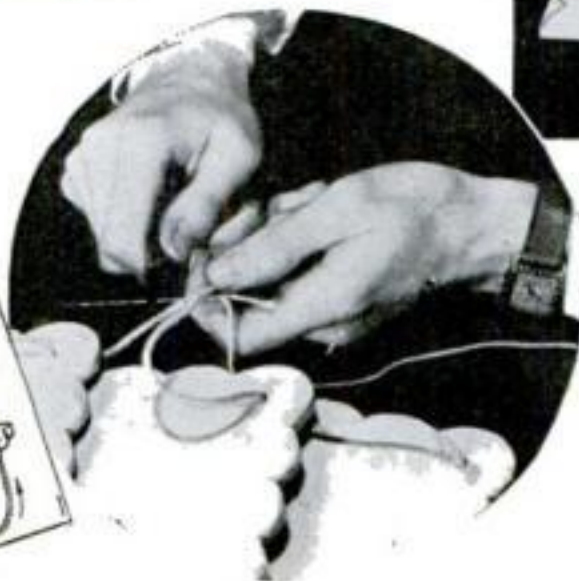
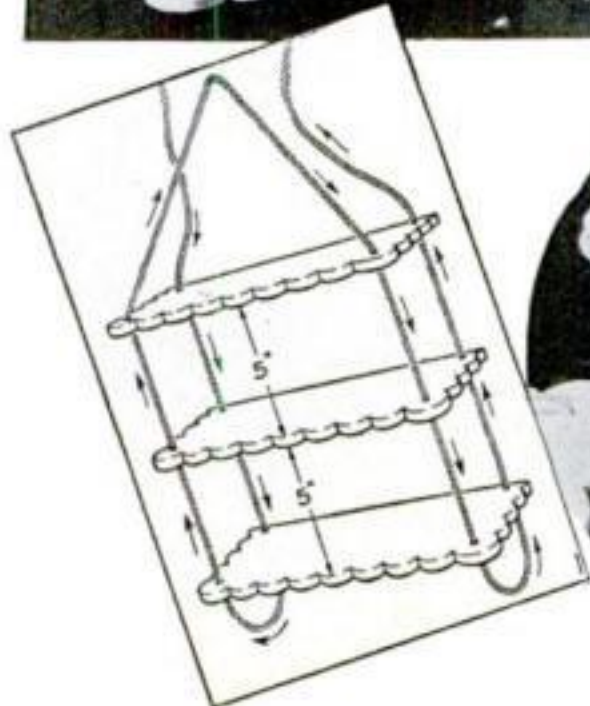
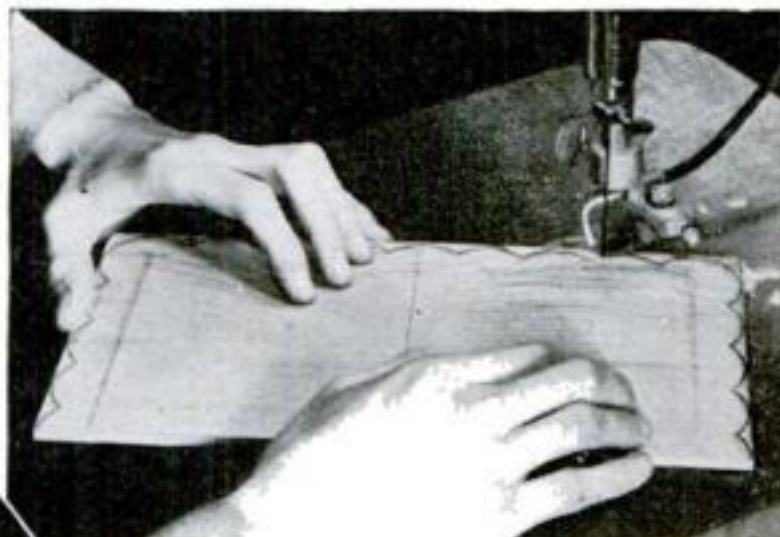
Light Hanging Wall Rack for Small Ornaments



INDOOR clothesline is used as the support for the three shelves of this attractive wall rack for holding small ornaments. The shelves themselves are laid out on $\frac{1}{4}$ " plywood, and the scalloped edges are cut with a scroll saw. In the corners, $\frac{3}{16}$ " holes are drilled for the cord. One coat of flat white paint or enamel undercoater is applied, and one or two coats of enamel of any color.

In stringing the shelves, one piece of cord is used. It is carried through the holes as indicated by the arrows in the assembly diagram. To support the shelves, string is knotted around the cord as shown in one of the photographs. Tassels are formed on the loose ends of the cord by unraveling the strands. Adjust the shelves to hang evenly before tying the bow permanently.

Scalloped edges are sawed on the shelves, which are then painted and strung together by means of one length of white cotton indoor clothesline

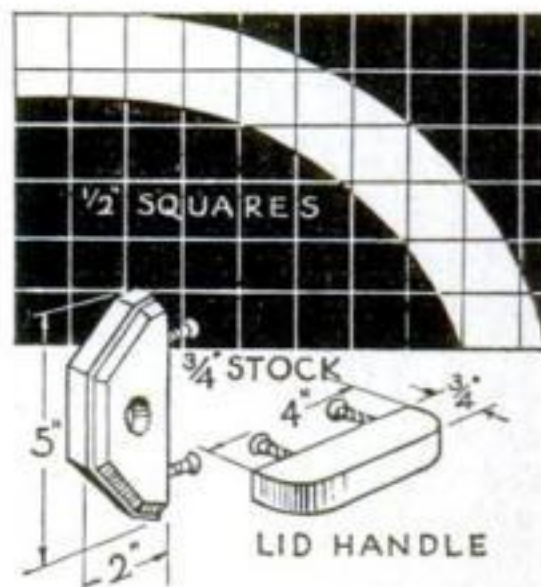
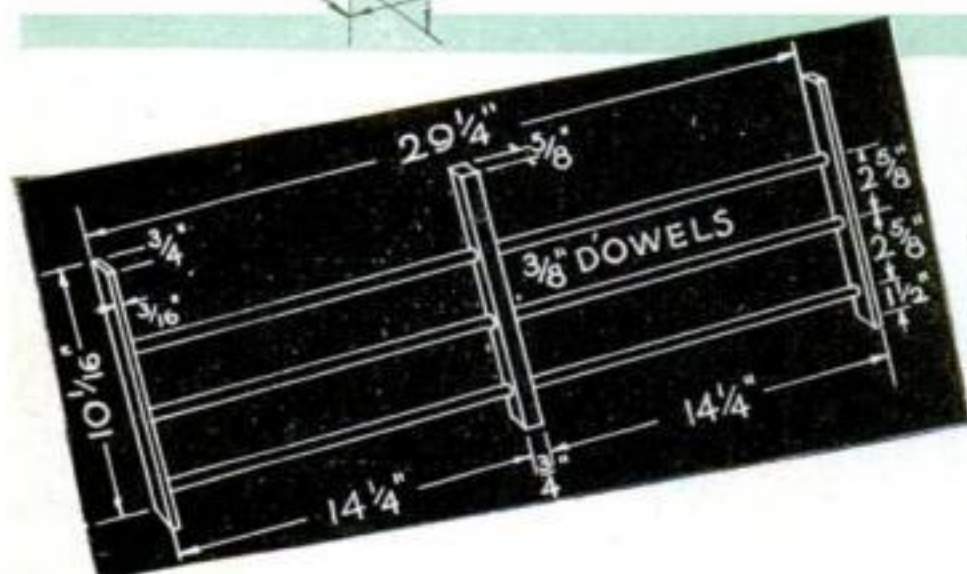
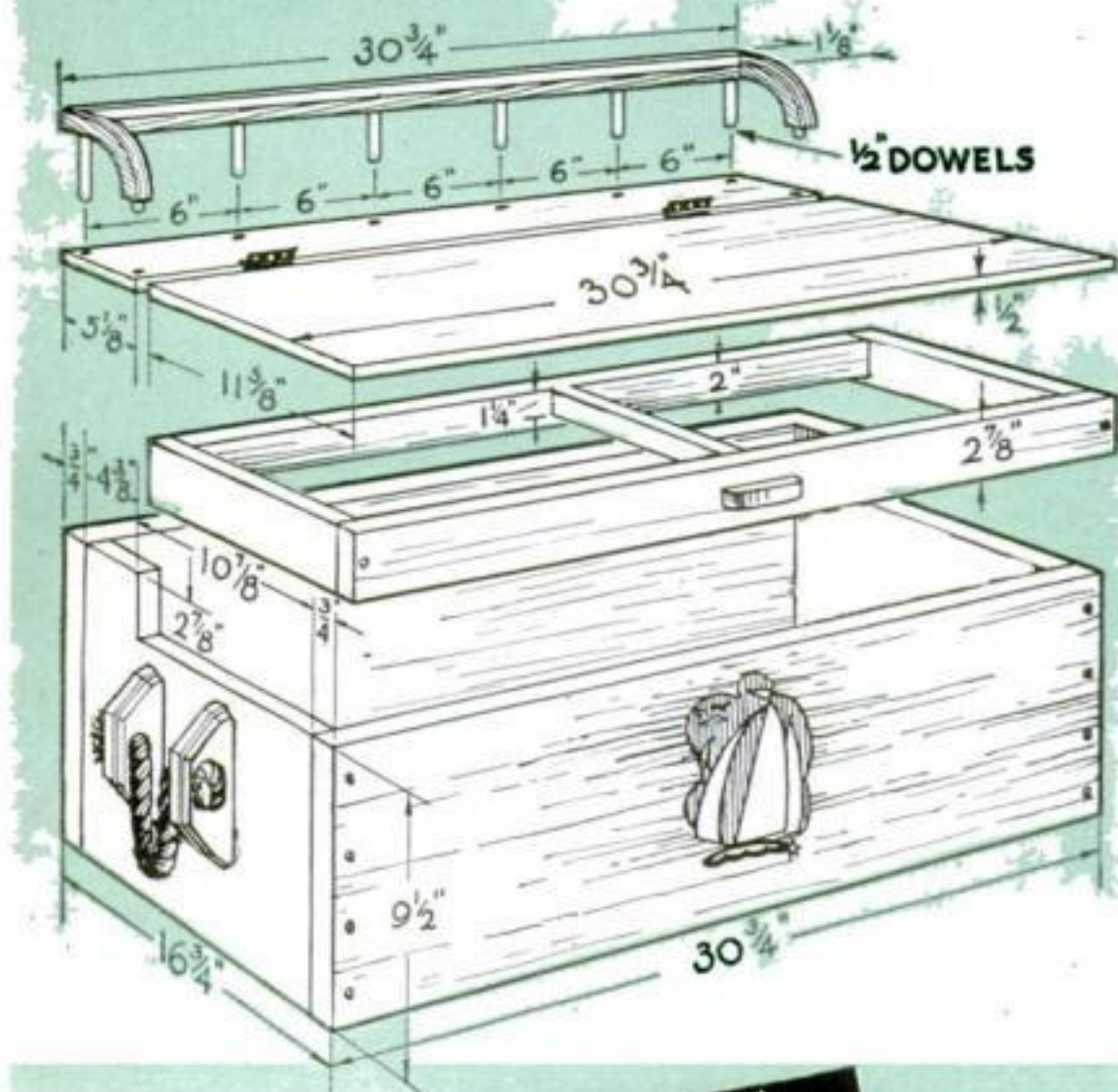




By **CHARLES JEGLINSKI**

A SEAMAN'S ship chest suggested the design of this useful piece of furniture. It can be used for holding toys, and there is a rack in the cover for story and painting books. The lid, which is upholstered, serves as a handy seat for dressing a child. The chest is equally appropriate for older boys and girls.

Pine, cypress, or other softwood may be used. The chest proper is first assembled from $\frac{3}{4}$ " boards. It can be built as an entirely inclosed box, and the lid section then cut away, or it can be made up of boards of assorted widths. However, I happened to have a $9\frac{1}{2}$ " board, so in making the original, I fastened two pieces $9\frac{1}{2}$ " by $30\frac{3}{4}$ " and two pieces $9\frac{1}{2}$ " by $15\frac{1}{4}$ " with screws set into counterbored holes. These holes were plugged with $\frac{3}{8}$ " dowel pegs $\frac{3}{8}$ " long, sanded round on one end. The bottom was cut and nailed inside, the nails later being covered by the rope trim. A three-sided top section was





The chest holds a lot of toys and there is a rack in the cover for story and painting books. The lid is upholstered in the simple way shown below

then made to fit on the upper edge of this box at the rear. It was doweled and glued in place, and a $\frac{1}{2}$ " board $5\frac{1}{8}$ " by $30\frac{3}{4}$ " was glued over this.

In making the cover frame, notice that the front piece overlaps the two sides and the back fits on the inside. The front is screwed and dowel-pegged to match the chest. A top $\frac{1}{2}$ " by $11\frac{5}{8}$ " by $30\frac{3}{4}$ " is glued and nailed on. The bookrack is then added as shown.

The ornamental rail is shaped on the spindle shaper, but it could simply be beveled. The back and sides are mitered together. Cut the sides to the quarter-round shape indicated, and assemble with dowels.

Four handle brackets are cut from $\frac{3}{4}$ " stock and given a molded or beveled edge. Bore a $\frac{5}{8}$ " hole in the center of each for the rope handles. Screw the brackets from inside of chest, and use glue also. They are placed $5\frac{1}{2}$ " from the edges of the chest, front and back, and $\frac{1}{2}$ " from the top. Do not add the rope handles until after staining and finishing the chest.

Maple stain is brushed on the wood and wiped off with a clean cloth. Allow this to dry overnight, then apply three coats of thin orange shellac. Rub with 3/0 steel wool. Add a hand-painted boat or a nautical decalcomania (transfer) if desired. Then polish the wood with furniture wax.

For upholstering, a nautical design in chintz or cretonne is used. The cloth, with the finished side down, is laid to overlap the back edge of the lid only 1". A piece of any ordinary cloth is laid on top of the upholstery material. Cut a $\frac{1}{4}$ " wide strip of



thin cardboard and tack to the very edge of the lid over the edge of the two fabrics.

A pillow is now sewed up to the width and length of the cover. Fill it with mohair and sew the opening. Let the two pieces of cloth dangle over the back of the lid and tack the pillow in place. A strip of cotton is next laid around the two sides and front to pad the sharp edge of the cover. The two fabrics are pulled over the pillow and tacked to overlap the sides and front 1".

Cut a strip of the upholstery material $1\frac{1}{2}$ " wide and long enough to go around the three sides of the lid. Cut a strip of cardboard $\frac{1}{2}$ " wide and fold the cloth around to make a binding. Tack this around to cover the tacked edges of the cloth. A $\frac{5}{8}$ " white cotton marine rope is now nailed over the binding with 1" brass roundhead nails. Large scalloped upholstery tacks are nailed in at each end to cover the ragged end of the rope. Do the same at the bottom.

The cabinet is 63" high, 16½" wide, and 10" deep. It is finished in rich amber



Gun Cabinet



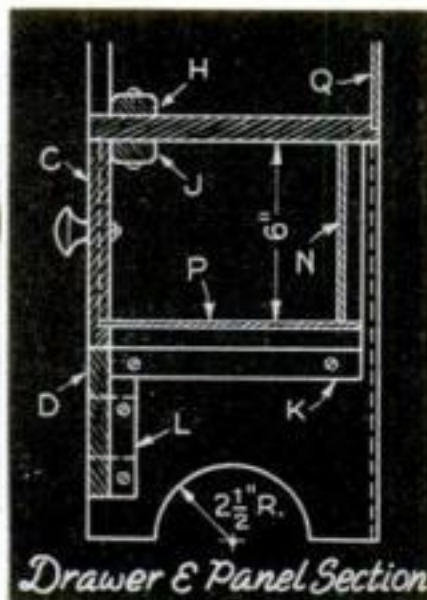
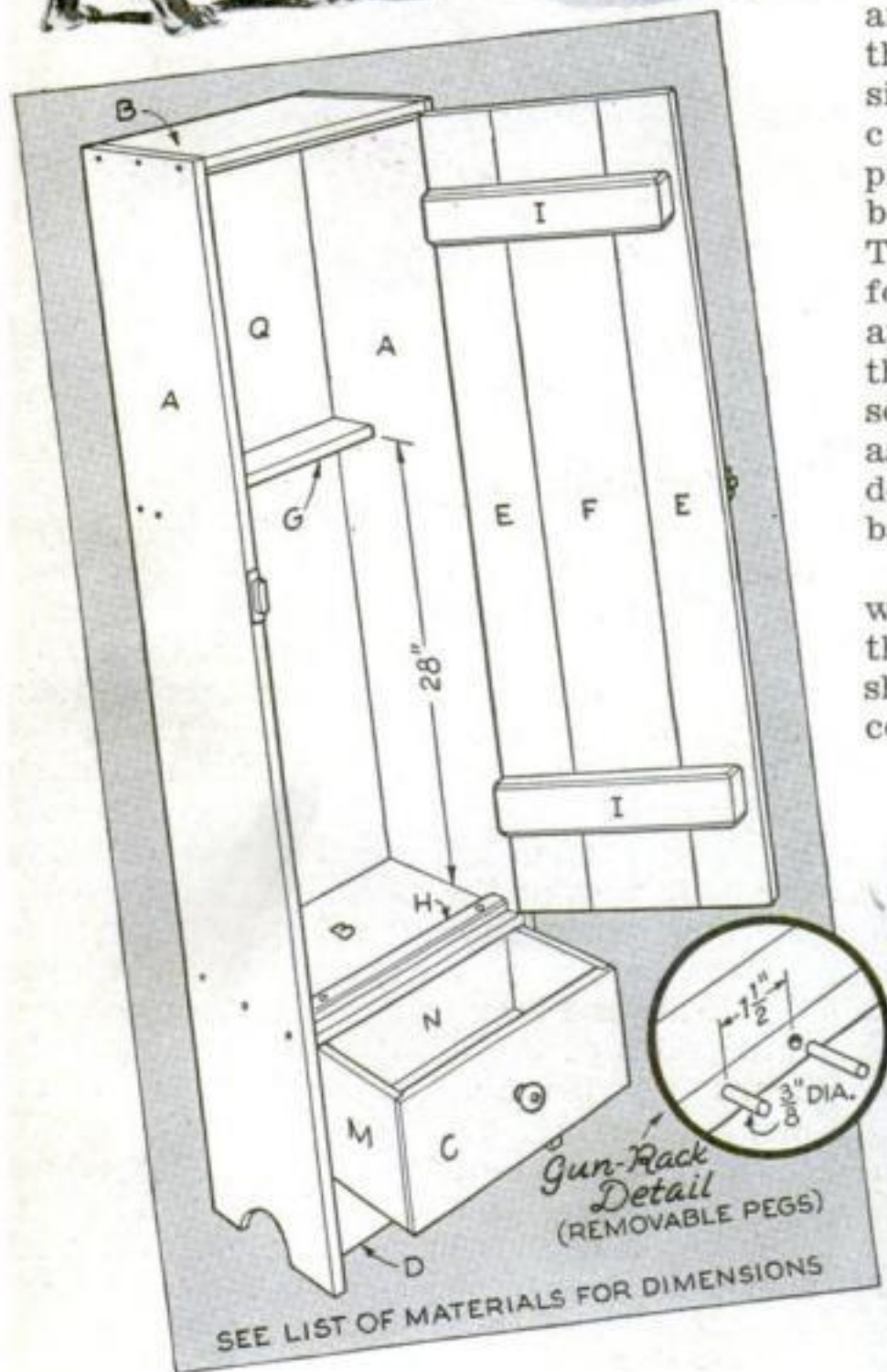
A CERTAIN rough-and-ready simplicity makes this knotty pine cabinet particularly appropriate for a sportsman's room. It is finished in a rich amber tone, and the silhouette of a dog ornaments the upper part of the door.

The cabinet is 63" high, 16½" wide, and 10" deep, outside measurements. Dimensions of all the pieces are given in the list of materials, and the parts have been lettered for ready identification.

Except for the plywood back, the cabinet proper is constructed of dressed white pine. The exposed parts are of a grade having sound knots; the gun rack and minor parts are clear stock. The thickness is nominally 1", but actually the wood is about ¾" thick. The widths can be changed slightly, if necessary, to suit the stock widths of the material available.

The rear edges of the sides *A* and the top and bottom *B* are rabbeted so that the ¼" thick plywood back can be set in. The dog silhouette (either design may be used) is cut from ⅛" thick pressed composition board and glued on. The gun rack *G* is bored for pegs, spaced 1½" apart. It is best to leave these unglued so that some may be removed as necessary when it is desired to store double-barreled guns.

The wood is finished with amber stain and thin coats of orange shellac, rubbed between coats with steel wool.



of Knotty Pine

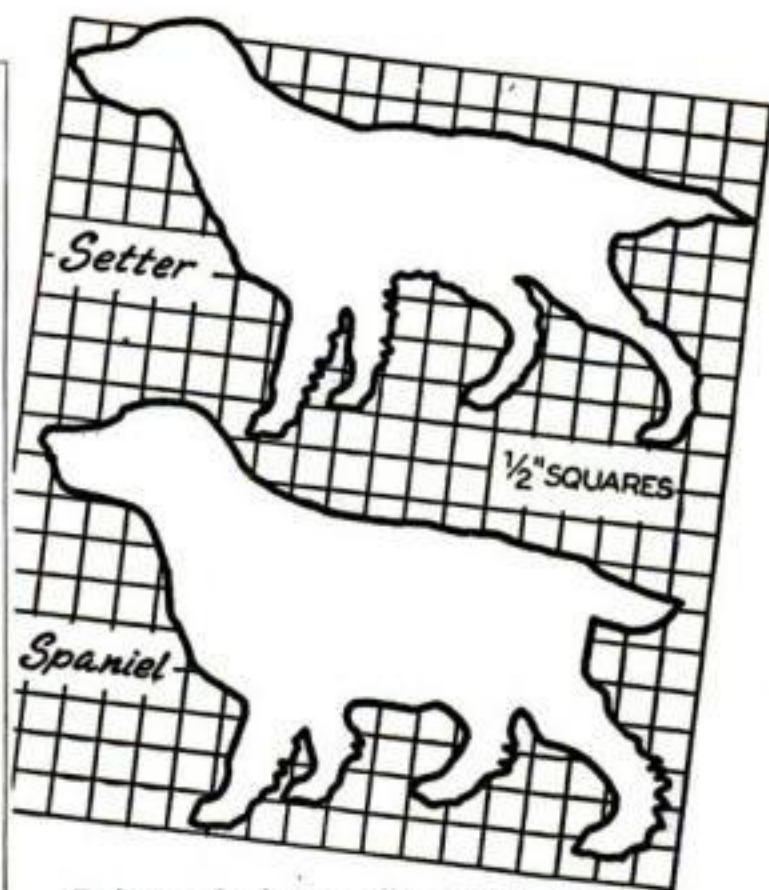
By
TOM E. MOORE

Oswego State Normal School,
Oswego, N. Y.

LIST OF MATERIALS

Part	No. Pc.	Name	Material	T.	W.	L.
A	2	Sides	Knotty pine	1	10	63
B	2	Top, bottom	" "	1	10	14 $\frac{3}{4}$
C	1	Drawer front	" "	1	7	14 $\frac{3}{4}$
D	1	Lower panel	" "	1	5	14 $\frac{3}{4}$
E	2	Door sides	" "	1	4 $\frac{1}{2}$	48
F	1	Door center	" "	1	5 $\frac{3}{4}$	48
G	1	Gun rack	Clear pine	1	3	14 $\frac{3}{4}$
H	2	Door stops	" "	1	1 $\frac{1}{2}$	14 $\frac{3}{4}$
I	2	Door cleats	" "	1	4	14 $\frac{1}{2}$
J	1	Drawer stop	" "	1	1 $\frac{1}{2}$	13
K	2	Drawer slides	" "	1	1	8 $\frac{1}{2}$
L	2	Panel cleats	" "	1	1	4
M	2	Drawer sides	" "	$\frac{3}{8}$	7	8 $\frac{1}{2}$
N	1	Drawer back	" "	$\frac{3}{8}$	6	14 $\frac{3}{4}$
P	1	Drawer bottom	Fir plywood	$\frac{1}{4}$	8 $\frac{1}{2}$	14 $\frac{3}{8}$
Q	1	Cabinet back	" "	$\frac{1}{4}$	16	49 $\frac{1}{2}$
R	1	Dog silhouette	Pressedwood	$\frac{1}{8}$	9 $\frac{1}{2}$	5 $\frac{1}{2}$

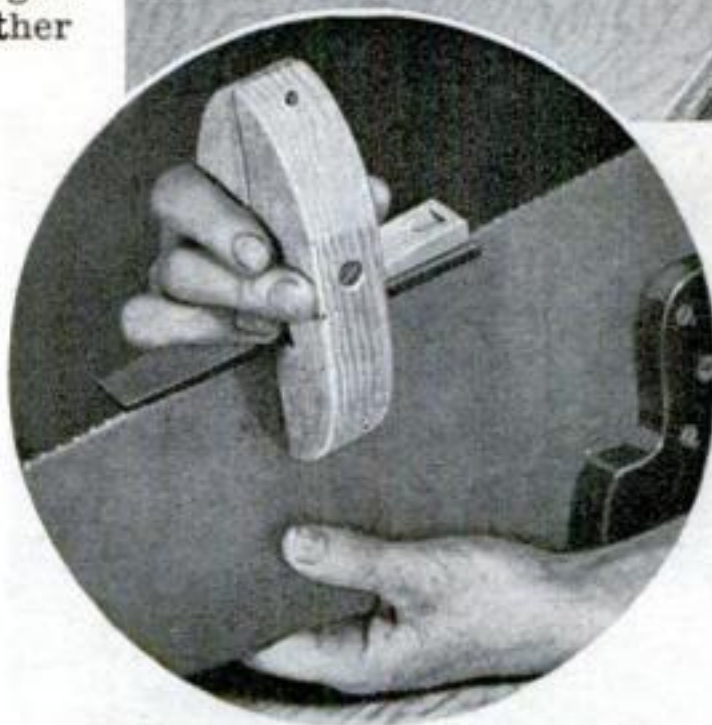
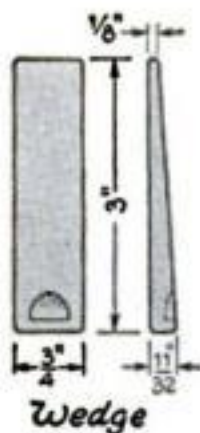
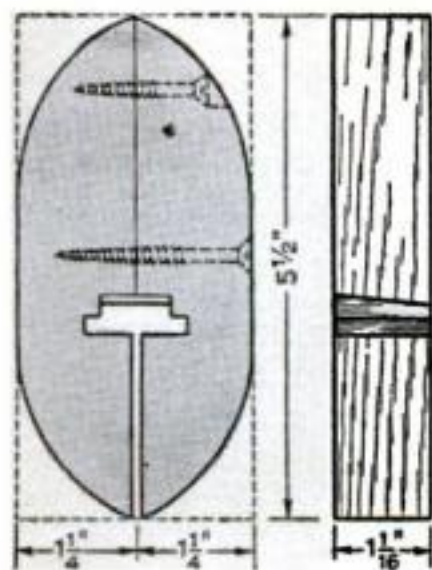
Note: All dimensions are given in inches.



Either of these silhouettes may
be used to decorate the cabinet

Gauge Simplifies Panel Marking and Saw Jointing

MADE on the circular saw in a few minutes, this hardwood gauge is used on a yardstick for marking panels and other large work. It also serves to hold a piece broken from a discarded file of about the same cross section as the yardstick so that the teeth of handsaws can be jointed easily to a straight line. Shape the parts as shown in the drawing below, but don't cut the bevel for the wedge slot until after the wedge is made. The slots can be cut on a circular saw. Be sure to make the two main parts of the gauge a pair, that is, right and left hand, so that they fit together correctly.—R. L.



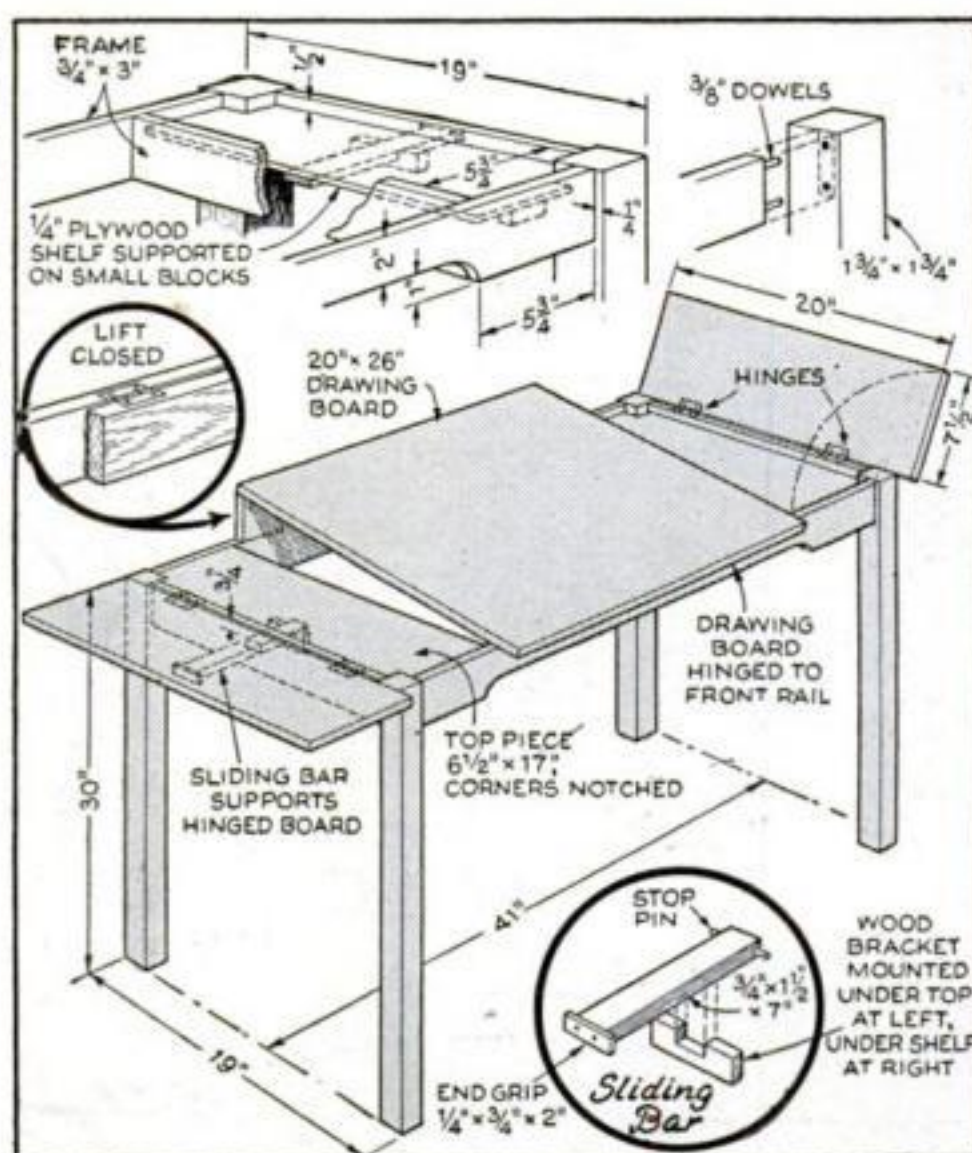
Using the hardwood
gauge and an ordi-
nary yardstick to
mark a measure-
ment on plywood

To joint the teeth
of a handsaw, fit
a piece of a dis-
carded file in the
gauge, as at left

A Drafting Table for Use at Home



The board is hinged to the front rail so that it can be lifted up and rested upon a narrow piece that turns up at the back



HERE is a home drafting table suitable for a small apartment. When closed up, it can be placed in the foyer or hallway and looks like an ordinary flat-topped table.

The center section of the top is a standard drawing board purchased in an art supply store. The remainder is constructed from clear white pine. The only hardware required is four pair of brass butt hinges $2\frac{1}{2}$ " long and about $1\frac{1}{2}$ " wide when open.

Use a jig for lining up the holes in the rails and legs for the $\frac{3}{8}$ " dowels with which the table is assembled. Before gluing, cut the front rail to the shape shown, and cut $\frac{3}{4}$ " by $1\frac{1}{2}$ " notches in the side rails for the sliding bars. Use long bar clamps in gluing the frame and let it dry overnight before removing them. Next, mount the drawing board by hinging it to the front rail so that it can be lifted up from the back and rested on another piece of wood that is hinged to the back rail.

Sand the table thoroughly and either apply a stained finish or paint to match other furniture or woodwork in the room.—A. J. SODARO.

• • •

A 1-QT. CARDBOARD milk carton that has been washed out makes a good quart measure for use about the shop or home with oil and other liquids. The measure may be thrown away after use.—O. W. LYON.

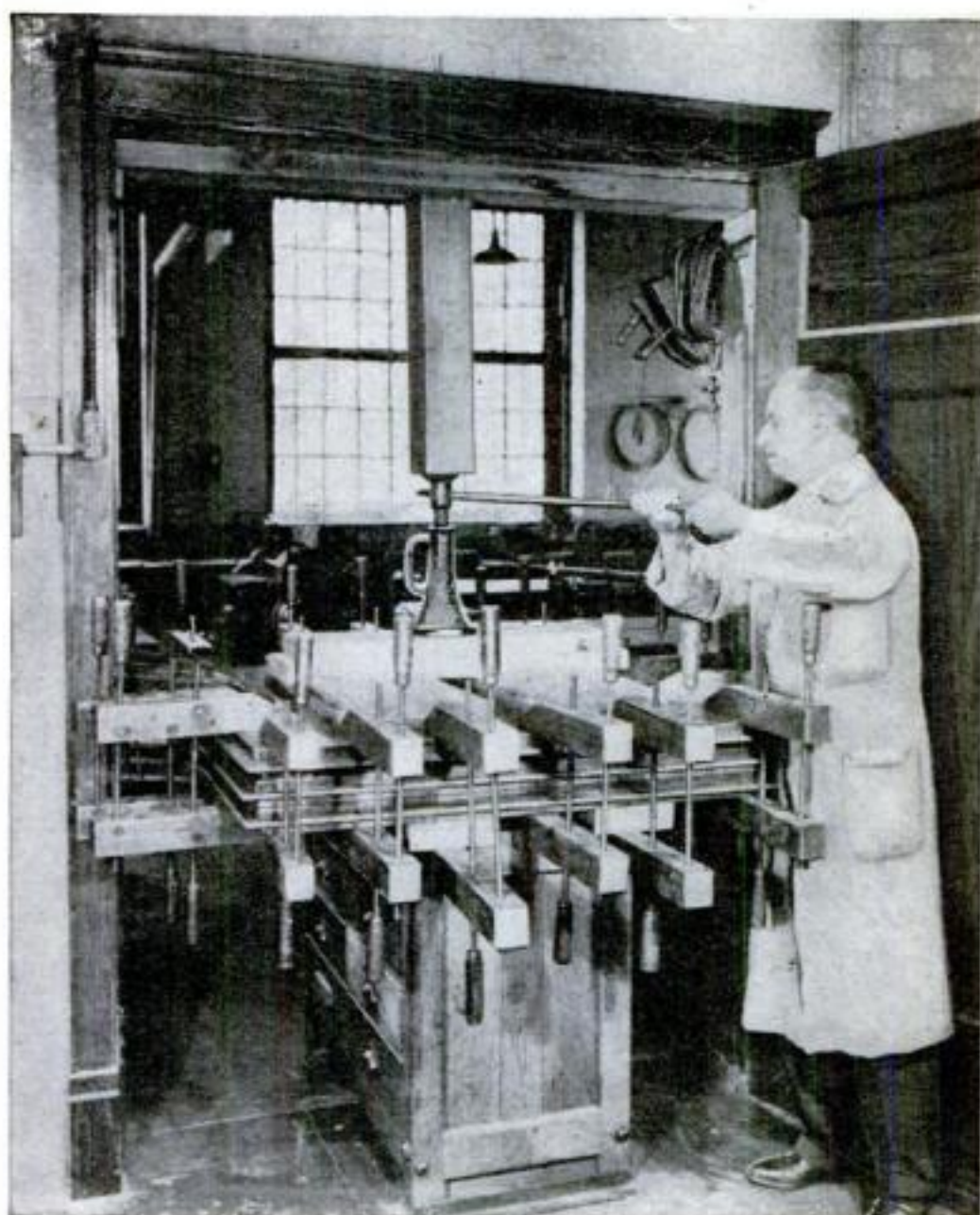
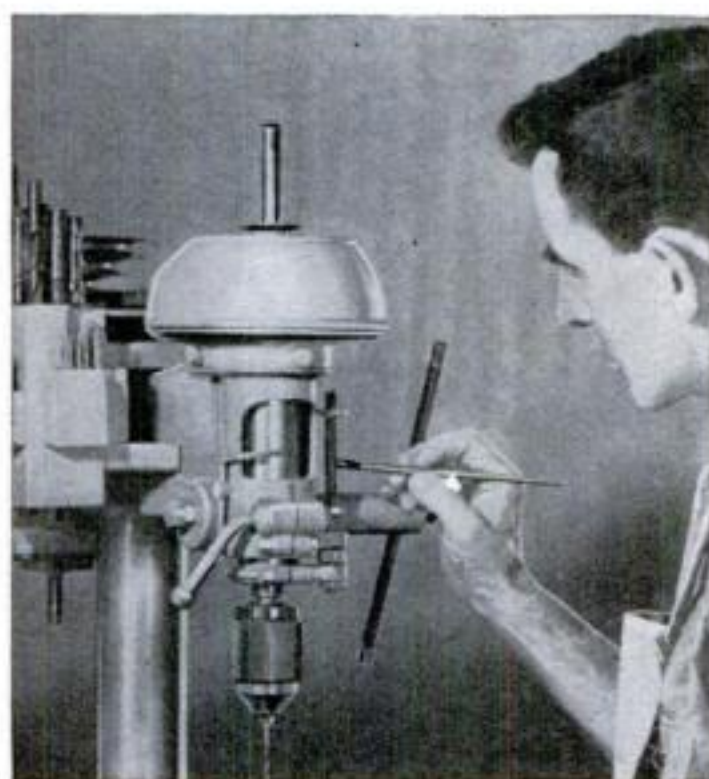


Above, the table may be placed in a foyer or hallway. Below, the table opened up

Stripes of Paint Anchor Stop Nuts on a Drill Press

DRILL-PRESS stop nuts often loosen and work down the screw when the machine is being used for boring holes of uniform depth. This can be prevented by applying a stripe of varnish or paint lengthwise of the screw. When dry, it makes the nuts bind sufficiently to hold one in position long enough to drill two or three holes.

This procedure avoids the bother of running the lock nut down the screw and often saves considerable time.—L. K.

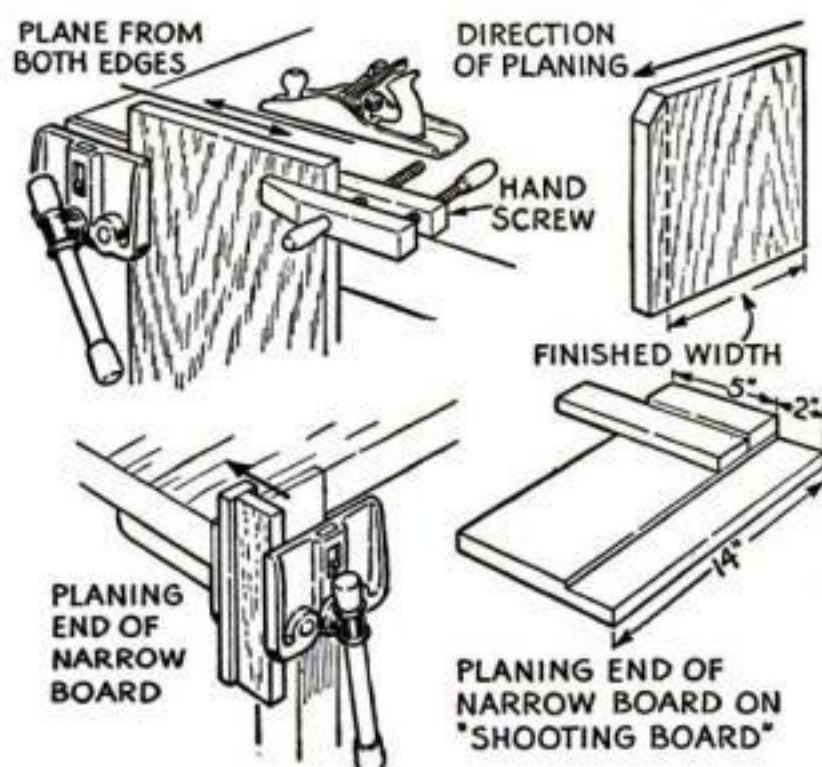


Jack Acts as Veneer Press

CONFRONTED recently with the problem of recovering a number of badly worn table tops with linoleum, I rigged up a large veneer press under a good-sized brick lintel. A house jack and a piece of 4" by 4" stock provided pressure at the center, and hand screws were used around the edge.—E. C. H.

PLANING END GRAIN

[WOODWORKING]



1. If the board is wide enough to be planed halfway from both edges, support the free end on the bench top by clamping a hand screw to it as shown.
2. If the board is narrow, but nevertheless wider than the finished width is to be, cut off one corner to prevent wood from splitting.
3. When the board is narrow and of the finished width, clamp another board behind it in the bench vise. A "shooting board" like the one illustrated may also be used in this case. Hold the board against the stop and use the plane resting on its side. A jack plane, smooth plane, or block plane can be used on end grain, depending upon circumstances, but for most small work the block plane is best.

POPULAR SCIENCE MONTHLY SHOP DATA FILE



NEW SHOP IDEAS



Draw-In Chuck



By
C. W. WOODSON

SPRING collets afford an accurate, convenient, and speedy means of holding drill rod and other finished bar stock in the lathe as illustrated in Fig. 1. They can easily be adapted to a precision lathe by the homemade draw-in chuck attachment shown in the accompanying photographs and detailed in the drawings at the end of this article. The drawings are exactly half the size of the attachment made by the writer for his own small lathe, but the dimensions obviously will have to be adapted to the lathe with which the draw-in chuck is to be used.

A collet adapter, draw-in spindle, and spindle cap (Fig. 2) are the parts needed, and these can be made on the lathe itself.

This particular attachment was designed for a 9" lathe with a $\frac{3}{4}$ " hole through the headstock spindle. The collets themselves may be purchased or made.

The handwheel in this instance was taken from a discarded valve. It was, however, given a finished appearance by being machined all over and polished bright. It was then bored to fit the hollow draw-in bar as in Fig. 3.

The hollow bar is a piece of cold-drawn seamless steel tubing $13\frac{1}{2}$ " long with an outside diameter of $\frac{3}{4}$ " and an inside diameter of $\frac{9}{16}$ ". This was chucked in the lathe to run dead true, and bored and threaded $\frac{5}{8}$ "—26 threads on the inside to receive the end of the collet. The tube was

now placed between centers and turned smooth as illustrated in Fig. 4. The center section was relieved slightly in this operation to avoid any possibility of its binding in the headstock spindle hole.

For the next step it was necessary to fit the handwheel to the tube. To clear the gear guard of the lathe, the wheel had to be placed in back of a long collar. The collar was recessed to fit over the back end of the spindle as shown in the drawings. This recess accurately centers the outboard end of the drawbar when in use.

The collet adapter shown in Fig. 2 is best made from a short bar of tool steel. Turned to dimensions and finished on the outside, as in Fig. 6, it was cut off and inserted in the spindle hole of the lathe. Here it was drilled and bored as in Fig. 7, and then carefully brought to dimensions, that is, twice the size shown in the drawings. Great care was taken in the boring of this part, as the collet must be supported at each end only and have clearance in the center for spring. The accuracy of the whole attachment depends largely on the accuracy of the work

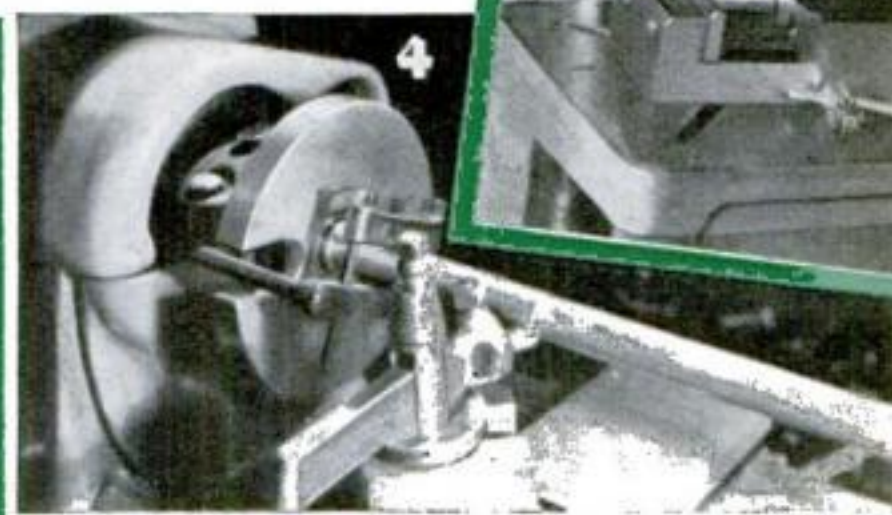
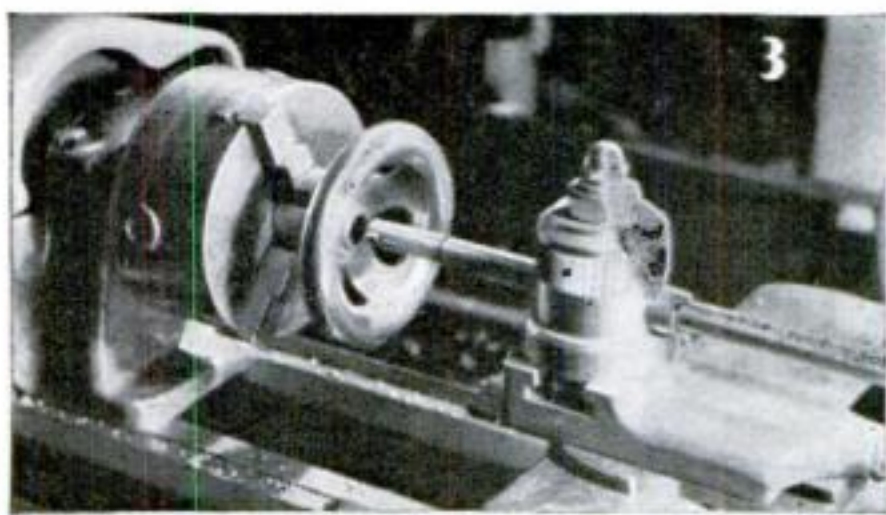
on the collet adapter. Every effort should be made to machine it perfectly.

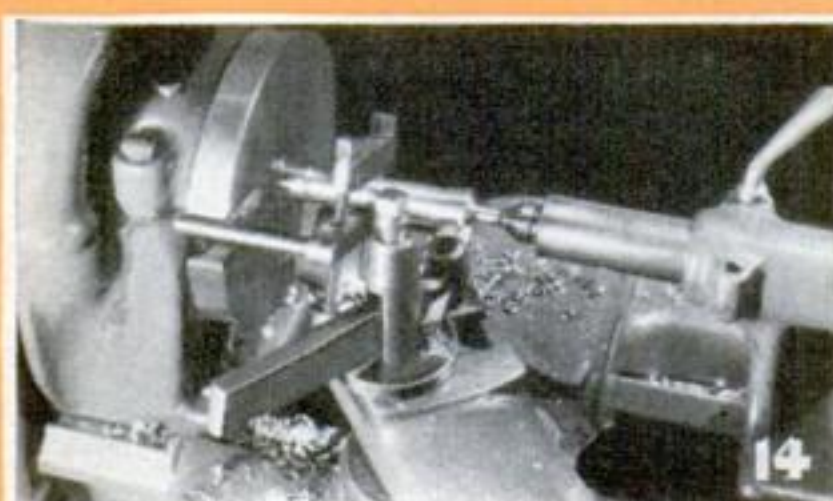
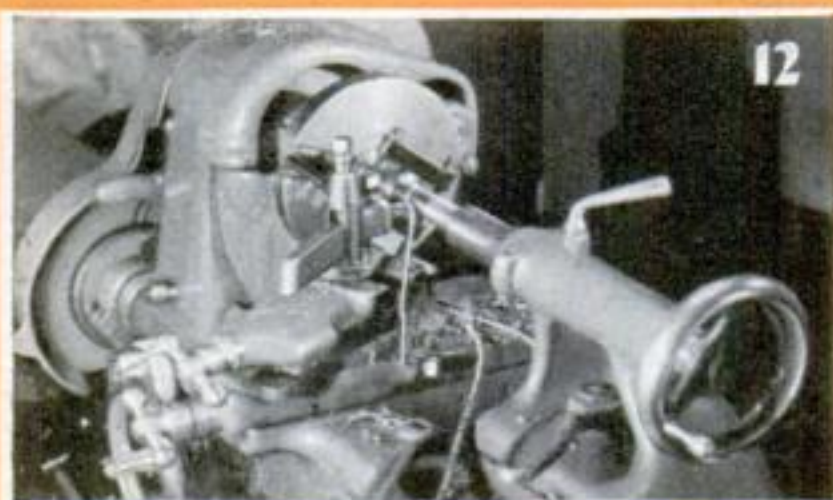
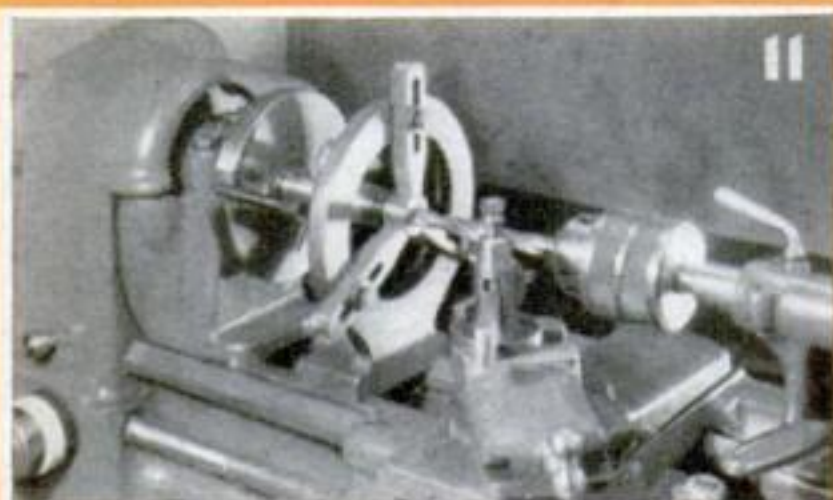
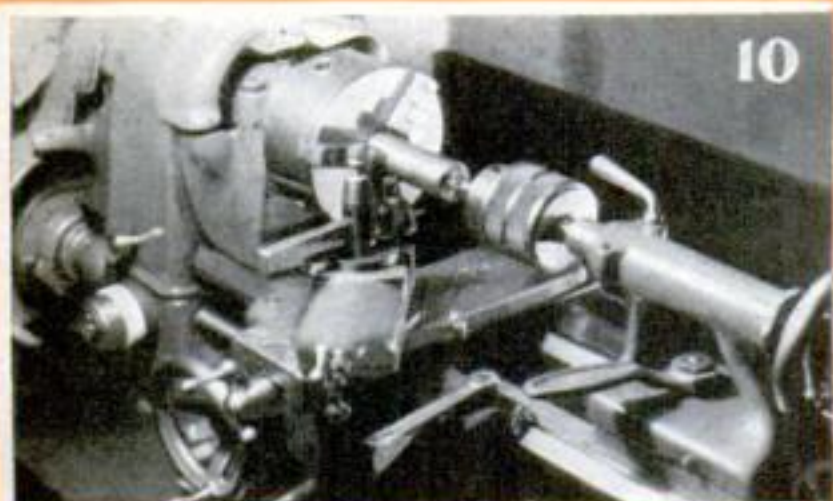
A feather, as shown in the drawing, is needed to drive the collet, and the adapter was drilled as in Fig. 5 to receive it. Riveting this in place finishes the adapter, which is then ready to receive the collets. These may be purchased or made up by the method to be described.

The spindle cap, also shown in Fig. 2, was made to afford protection to the threaded end of the headstock spindle nose. A short piece of cold-rolled steel was chucked as in Fig. 8, bored, and threaded, the inside dimensions exactly duplicating those of the small faceplate that comes with the lathe. When threaded and counterbored, it was knurled while chucked as in Fig. 9. This finished the work on the attachment.

The spring-tempered collets are best made from tool steel, hardened, tempered, and ground accurately to size. A set of eight, ranging in size from $1/16''$ to $1/2''$ by six-

and Spring Collets





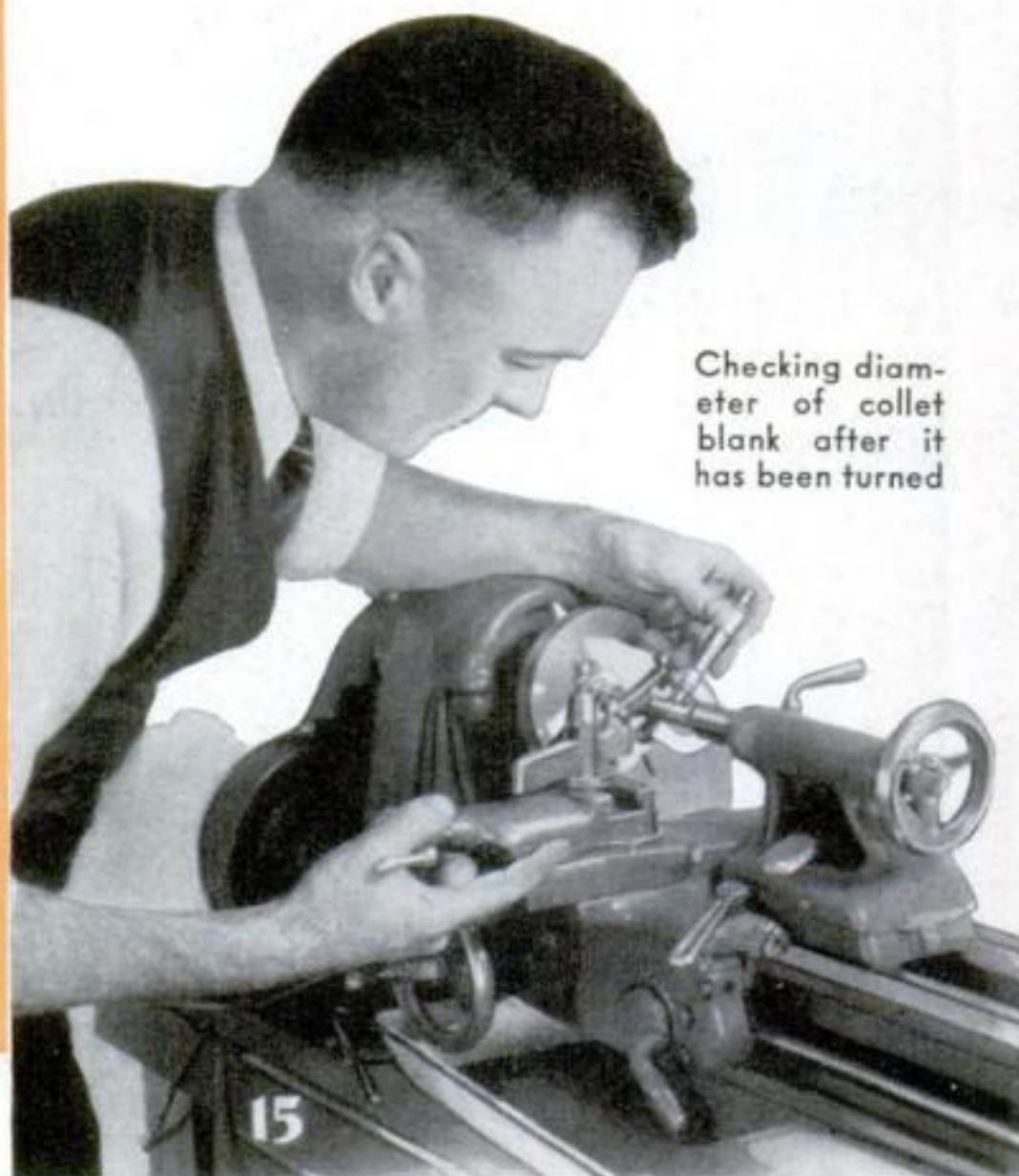
teenths, is desirable (Fig. 2). It is well to use a bar of steel slightly larger in diameter than the collet, and $\frac{1}{4}$ " longer. This makes the blank about $\frac{7}{8}$ " by 3", which is chucked as in Fig. 10 and centered on both ends.

A roughing cut is taken before mounting the stock in the center rest, where the large clearance hole is drilled and bored (Fig. 11). The outer end of the hole is beveled 60 deg. to receive the tailstock center, and the collet is turned to shape as shown in Figs. 12 to 15. A slight allowance must be made for grinding to exact size after hardening.

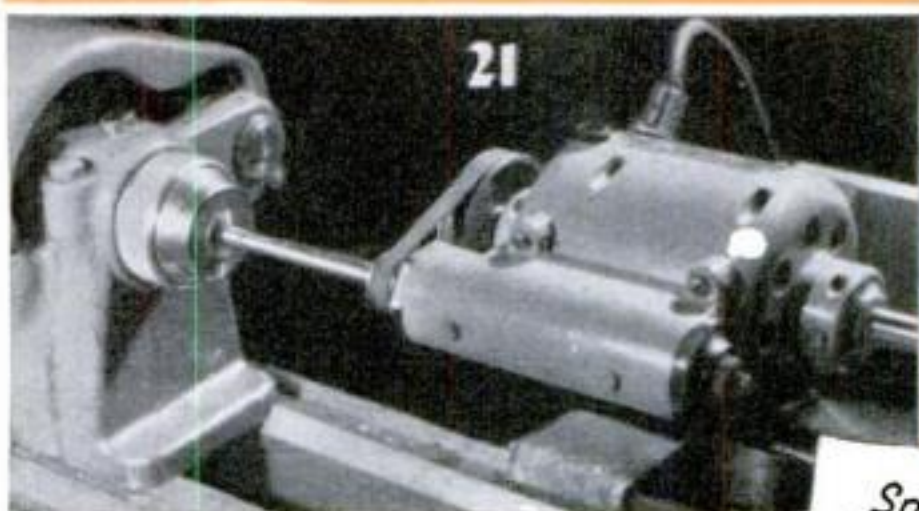
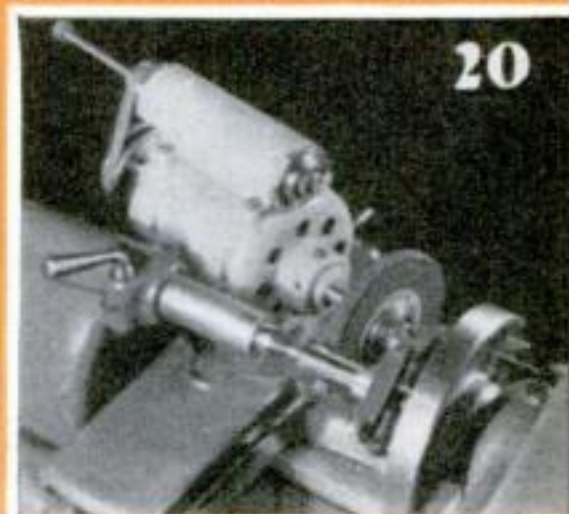
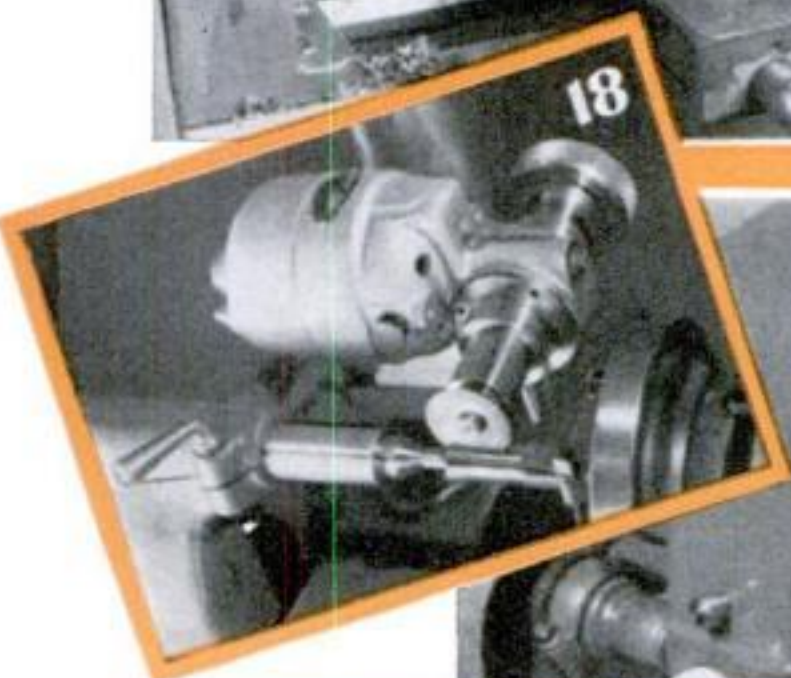
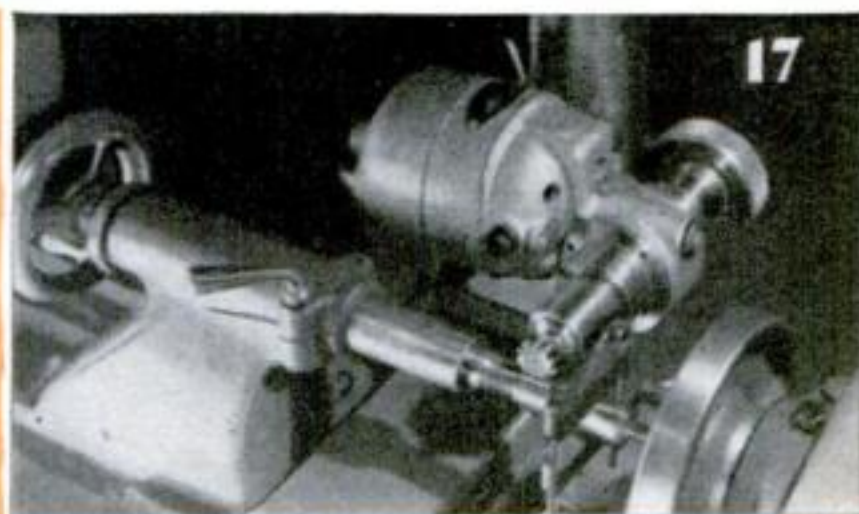
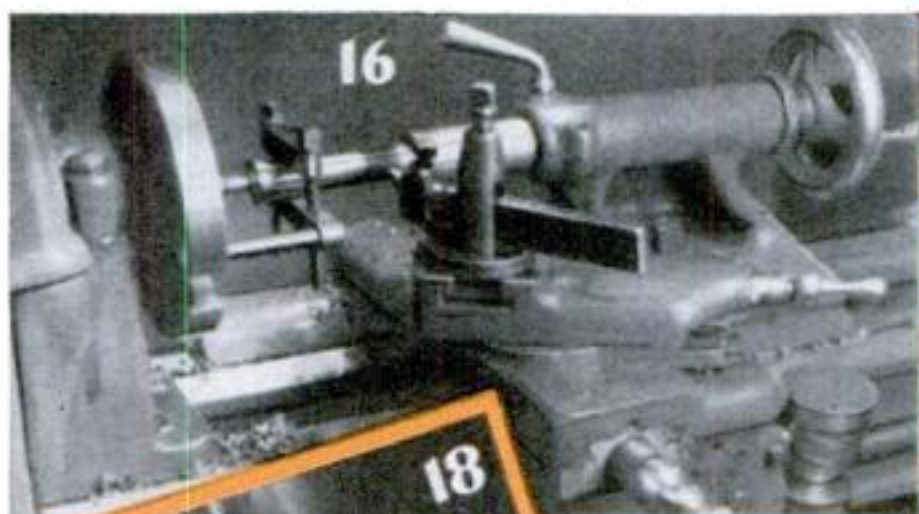
The $\frac{5}{8}$ "—26 thread is cut on the end as shown in Fig. 16 to fit the threaded hole in the draw-in spindle. While still in this position, the keyway for the driving feather is milled as in Fig. 17, and the three slots are cut (Fig. 18). These slots are not cut through the center support left on the collet, but should be cut far enough out to clear the hole and far enough back to allow for spring in the collet. The metal-slitting saw should be thin and of small diameter.

The collet can now be mounted in the adapter in place on the lathe spindle, as shown in Fig. 19, where the hole to receive the work is drilled slightly smaller than finished size to allow for grinding after hardening. The finished hole size should now be stamped on the end of the collet, and it is ready for hardening and tempering.

If an open fire is used for hardening, it is best to place the collet in a metal tube and bring to a low red heat. Then plunge it a



Checking diameter of collet blank after it has been turned

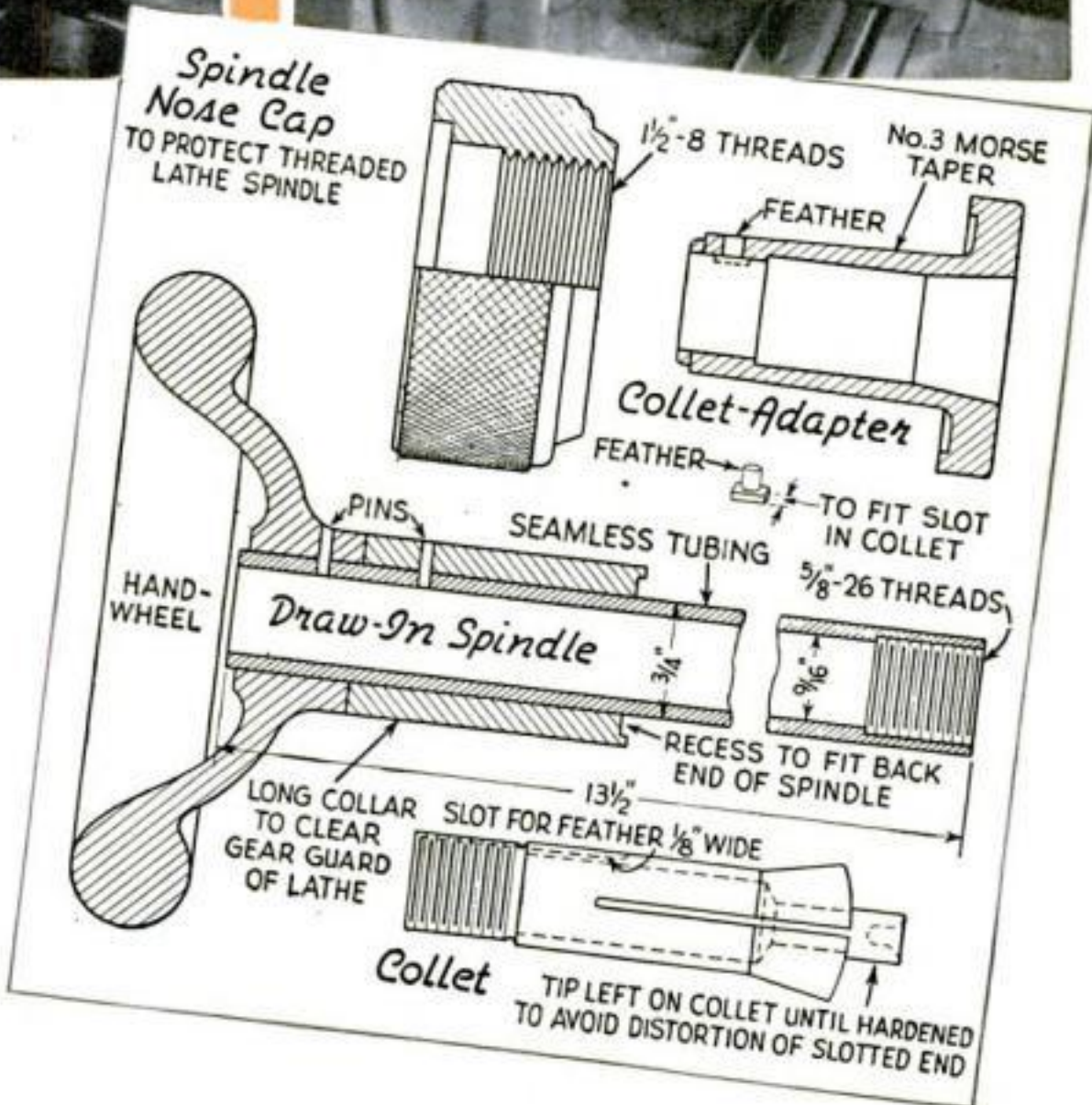


little over half its length in water. The temper is now drawn, and the collet is ready for grinding to finished size. This is done in the lathe with a tool-post grinder as shown in Fig. 20, or a hand motor grinder could be arranged to do the work.

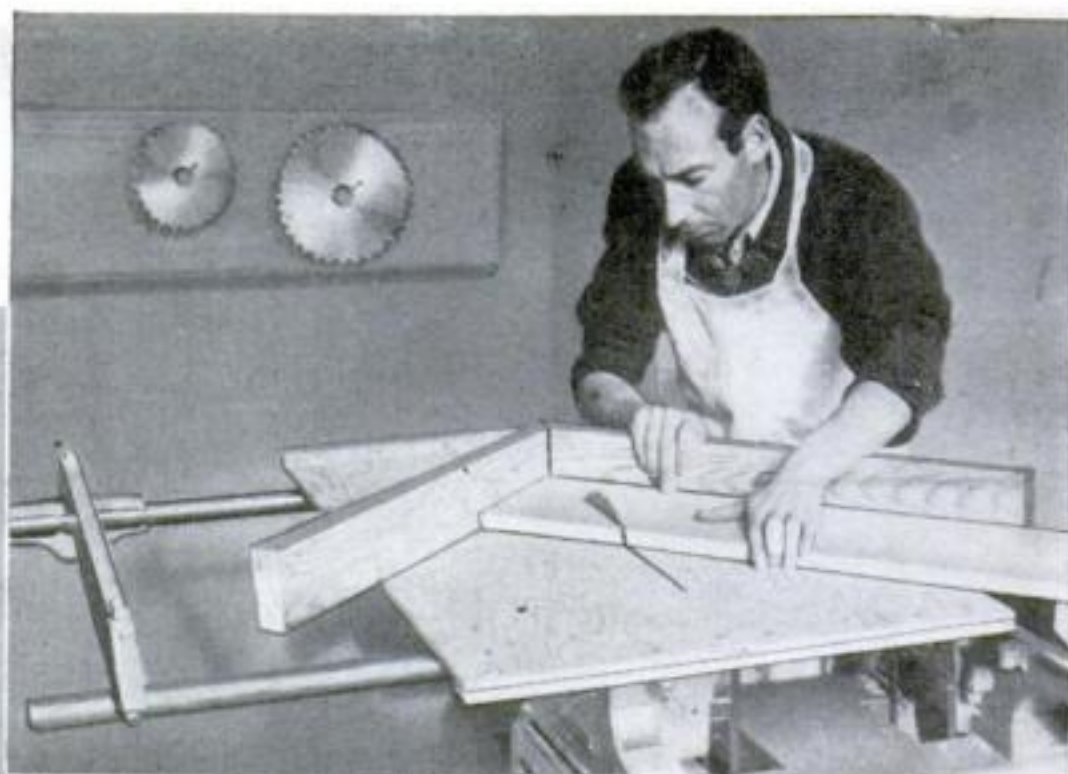
In Fig. 21 the hole is being ground to size by the internal attachment of the grinder, which should be operated at the highest possible spindle speed. The lathe itself is run at a slow speed.

Figure 22 shows the center support being ground away. After being polished, the collet is ready for use.

The hole size of the collet should closely approximate that of the work to be held, and the collet should never be closed without work in the hole.

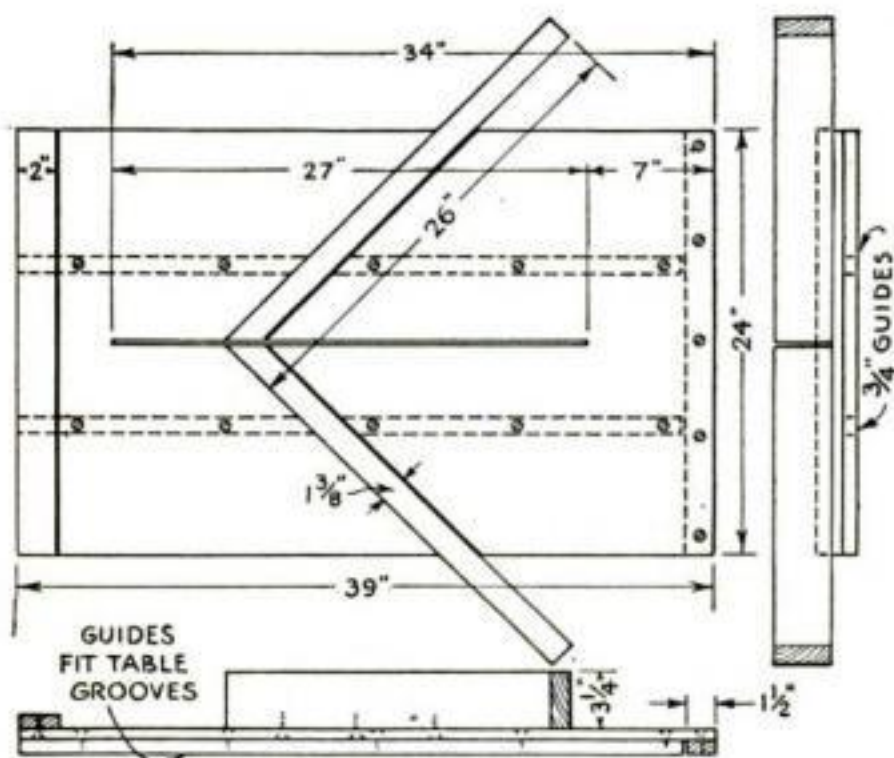


A Jig for Cutting Miters Speedily on a Table Saw



Maple strips underneath the miter board slide in the grooves of the saw table and guide the jig as a miter is cut by the circular saw

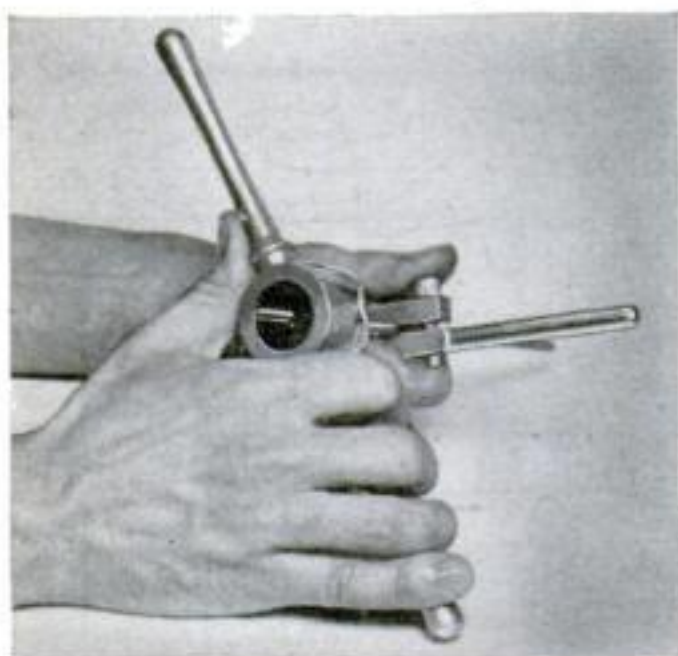
Using the jig to cut a miter on a crown molding. A great many uses for the board can be found in a carpenter shop



IN A carpenter shop where a great many inside and outside miters have to be cut, the time spent in making this miter board for a circular saw will be saved over and over again.

The board is made of $\frac{3}{8}$ " plywood with maple cleats at the ends, one on top and one below, as shown. Maple guides are fastened with screws through the top to fit the saw table grooves accurately. These should be so placed that the saw cut may be made in the middle of the plywood after the guides are in place by turning the saw up through the plywood. Fasten the fences accurately and strongly with screws from the underside after placing glue beneath the mitered ends.—CHARLES A. KING.

Tap Wrench Holds Rods and Tubing for Threading



A TWO-PIECE adjustable tap wrench of the ten-cent variety is useful as an improvised vise for holding small diameter rods, tubing, or pipe for threading. It

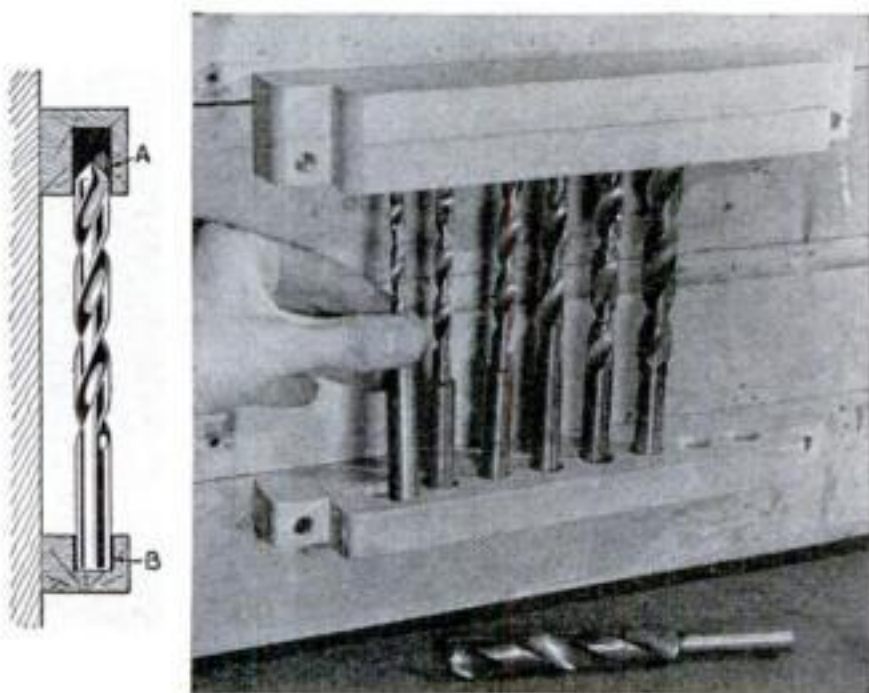


How a small rod is held for threading

gets a good grip without excessive pressure, and doesn't chew the stock up. I have even threaded $\frac{1}{8}$ " iron pipe in this way without difficulty. The wrench can be carried in the pocket and eliminates the need of a heavy vise.—A. T.

Wooden Rack Protects Bits from Damage

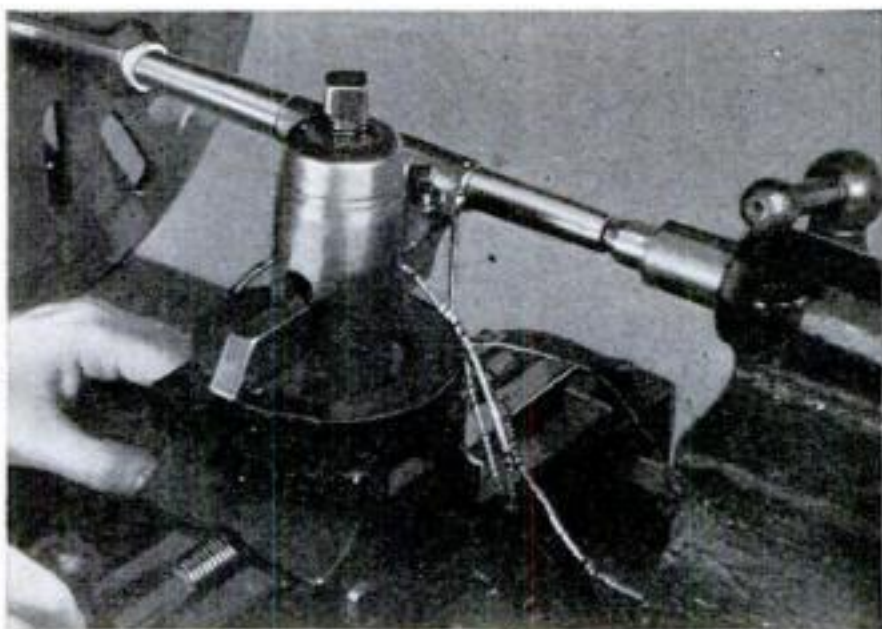
FOR holding twist drills, auger bits, and other tools which should have their ends protected, a rack may be made of two strips of wood with holes bored as shown below. The strips are so spaced that when the upper end of the tool is pushed into an upper hole, the lower end can be swung in and dropped into a lower hole, yet the tool does not drop down so far that the upper end is released. To remove the tool, simply lift it up and swing the lower end out.



Rack made of parallel wooden strips having holes aligned vertically. Upper holes must be deeper

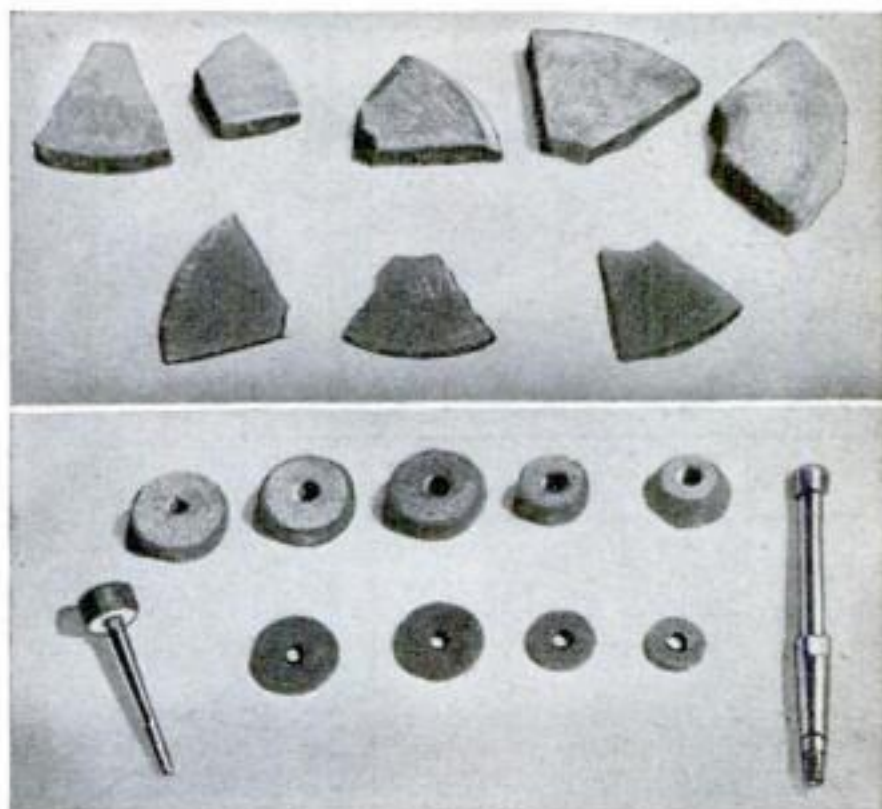
Two Small Tapered Parts Turned at One Setting

CONSIDERABLE time may be saved when turning several tapered parts for lathe fittings, handles, and the like if two are turned on one piece of stock. Separate the tapers after fitting to the socket. In the case of lathe fittings, insert the tapered shank in the headstock spindle to hold it while doing any additional machining.



Workshop Towel Hangs from Rubber Holder

IF A SHORT piece of radiator hose, cut as shown, is tacked on the wall of the workshop above the lavatory, it forms a quick-acting holder from which the towel may be jerked carelessly without being torn.

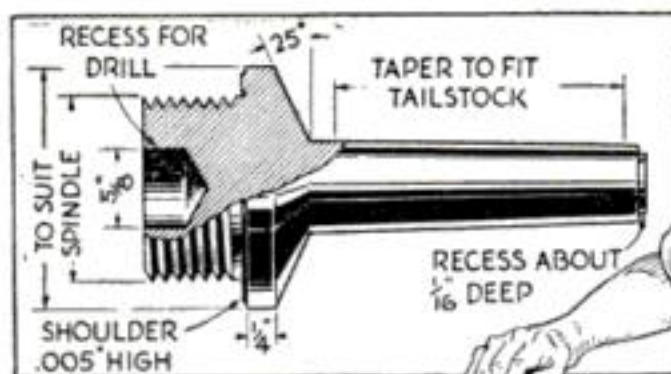


Worn Grinding Wheels Cut into Tiny Ones

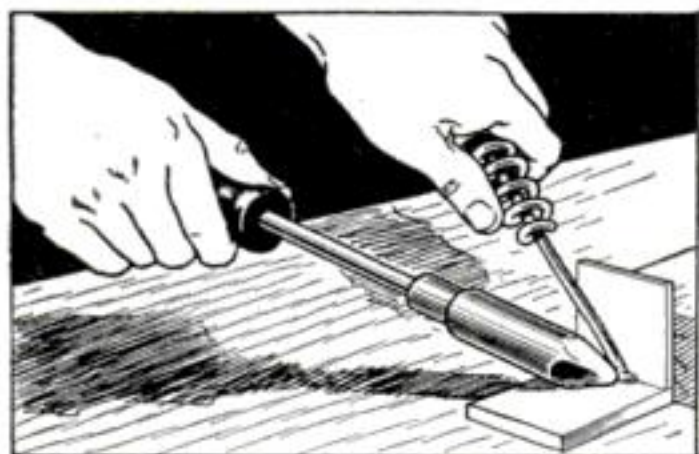
TOOL-POST grinding wheels 1" in diameter and smaller are rather expensive in comparison with wheels from 4" to 6". When, therefore, bench grinder wheels of $\frac{1}{8}$ " to $\frac{1}{4}$ " face become worn too small to cut properly or are accidentally broken, it pays to cut them up into small wheels. Chalk one side white, draw the desired circle with pencil, and drill the hole with a regular drill, but use water for a coolant. Shape the diameter with a bench-grinder wheel; then dress the small wheel as required.

Lathe Tailstock Arbor Holds Faceplate or Chuck

AN ARBOR of the type shown is a useful lathe accessory for holding a chuck or faceplate in the tailstock. It is handier than an ordinary drill pad because, when a faceplate is fitted to it, metal or wood pieces can be attached to serve as a jig for drilling duplicate pieces. The drill or drill chuck is held in the headstock spindle. The special arbor should be finished in the spindle of the lathe. If the work is carefully executed, it should be true to less than 0.001" as to squareness when placed in the tailstock for mounting a chuck or faceplate.—ELMER A. HUBBARD.



TO GRADUATE accurately the side or circumference of a handwheel or similar part, fit the required lathe threading gear to a suitably made head center; fit an indexing screw to a member bolted to the bed of the lathe, and scribe with a sharp-pointed threading bit set in a tool holder and at right angles to the conventional position.—H. J. C.



Solder Coiled Compactly

A CONVENIENT way to handle wire solder, especially when it is necessary to get into tight places, is to roll it around a pencil, then pull the pencil out and push one end of the wire back through the center as illustrated at the left. Wind the loose end down around the straight end. As you use up the solder, pull the end out.—P. R.

INK FOR MARKING METALS

[FORMULAS]

Gum arabic	8 grams	Copper Sulphate	20 grams
Sal ammoniac	16 "	Hydrochloric acid, concentrated	10 cc.
Lampblack	4 "	Water	20 cc.

Soften the gum arabic in the heated water; add the acid slowly while stirring; then the sal ammoniac; next the copper sulphate, and finally the lampblack. Apply with a fresh steel pen, a quill cut from a large feather, or a rubber stamp. Before using the ink, see that the metal is freshly polished, and clean it with denatured alcohol and a cloth.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

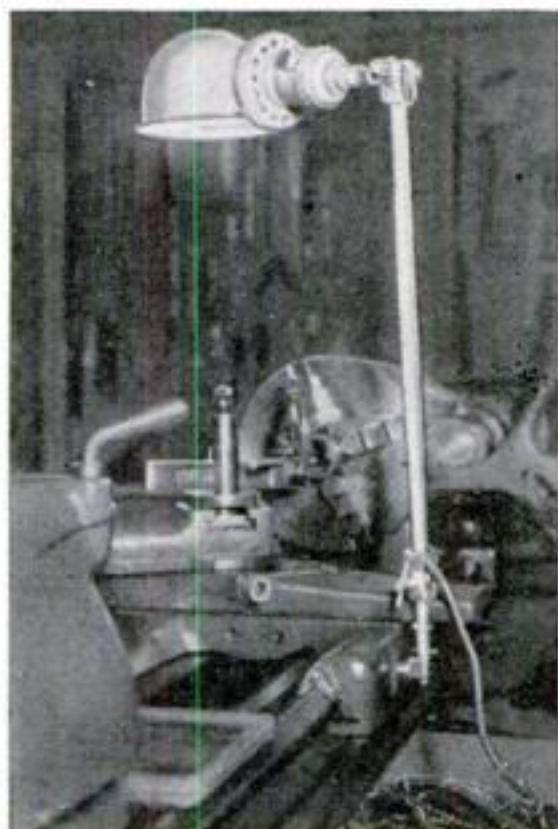
Brush Presses Inner Tube Against Buffing Wheel

IN SEARCH of a convenient handle for holding inner tubes safely against a buffing wheel preparatory to patching them, one mechanic discovered that a discarded paintbrush was well adapted to the purpose, as illustrated at the right.

• • •

WHEN soldering the outside of the bottom and sides of milk cans, pots, pails, and the like, it helps to place an electric lamp beneath or inside the article. Any holes can then be readily seen.

Old Table-Lamp Standard Utilized as Lathe Light



AN OLD table-lamp standard, with base removed, was used for this lathe light. It was fastened on the back of the carriage with a small bracket. This type of illumination is most practical because the light moves with the carriage and therefore is always directed on the tool so the operator can see what is done.
—D. D. FULMER.



The inner tube is held safely against the buffing wheel with the aid of the old brush

Paper Glued to Thin Shims for Easier Handling

TO LAY out and cut shims from very thin brass or steel, first glue a sheet of white paper on the stock. When dry, the stock is much easier to handle, and the holes and shapes can be marked plainly with a sharp pencil. The paper is removed after the shims have been cut by soaking them in water for a few minutes, then peeling it off.—CHARLES HOMEWOOD.

LUBRICANTS for Drilling, Counterboring, Countersinking [SHOP METHODS]

MATERIAL BEING WORKED	SUITABLE LUBRICANTS							
	Dry	Milk	Lard oil	Paraffin oil	Soap mixture*	Kerosene	Turpentine	Soda water†
Aluminum						X	X	X
Babbitt			X					
Brass	X			X				
Bronze	X							
Cast iron	X							
Copper		X						
Glass							X‡	
Hard steel						X	X	X
High-speed steel			X					
Lead			X					
Machine steel			X		X			X
Malleable iron								X
Monel metal			X§					
Soft alloys (of aluminum, etc)						X		X
Soft steel			X		X			X
Wrought iron			X		X			X

* Water, 2½ pt.; soft soap, 1 oz.; sodium carbonate, 1 oz.; lard oil, 1 oz. Mix and boil forty minutes before using.

† Sodium carbonate (sal soda, washing soda, etc.) in water. The sodium carbonate used by photographers will do.

‡ Dissolving camphor in the turpentine will improve the action in drilling glass.

§ Use slow speed in drilling.

Note: Never use lubricating oil on a drill bit.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Painting Questions



HOW TO REMOVE DRIP STAINS FROM ASBESTOS SHINGLES

My new asbestos shingle side walls have a drip stain here and there under window sills. I have tried to remove these with gasoline, but with no effect. What should I use?

Use one cup of trisodium-phosphate powder to a pail of hot water. Scrub the stained area thoroughly, then rinse with clean water and a sponge.

WHY OUTSIDE PAINT CHECKS

Last year we painted our house blinds, and now they are badly checked and alligatored. Did the painter use too much drier, or what is the trouble?

It is possible that too much drier was used, but it is much more likely that a hard-drying paint was applied over a soft coat,

in which case alligatoring or checking always occurs. The use of prepared paints over lead and oil will cause the same thing. Either system, however, is good when used throughout.

The only practical method is to strip the blinds in a tank of boiling trisodium-phosphate solution, using a pound to a gallon, and scrub them clean with a palmetto fiber floor scrubbing brush. Hose off with clean water, let dry thoroughly, sand where necessary, and repaint with the new, nonfading type of outdoor enamel intended for trim and trellises. Two coats will be required.

WHAT TO USE FOR RUBBING

I notice that you specify the use of FFF pumice stone and crude oil for rubbing varnish. I have always used rottenstone and linseed oil. Which is better?

FFF pumice stone and crude oil or light golden paraffin oil do a better and faster job than does rottenstone. The latter is too fine and too slow for anything except polished pianos, which, by the way, are seldom polished as in the past. Linseed oil should never be used in rubbing as traces left in corners dry to a sticky mass that is hard to remove. The crude oil or paraffin oil is easy to remove with a stiff brush and a mixture of one part oil and two parts gasoline. Wipe clean.

PAINTING WITHOUT DRIPS

I have been decorating my living rooms with the new type of water casein wall paint. I find this material most satisfactory, but the brush drips badly, especially on overhead work. How can I stop this?

Master painters frequently give their men two 6" brushes for this work, only one of which is used at a time. One brush is dipped 1½", spatted against the inside face of the pail, and then used to brush overhead. This is continued until the brush starts to leak, at which time it is wiped across the edge of the pail until clean. It is then hung on the pail with a hook, and the work is continued with the second brush.

In lieu of a second brush, get a child's rubber ball, cut it in half, punch a hole in the crown side, and slip tightly over the brush handle with the hollow side facing the bris-

Answered **By** RALPH G. WARING

tles. The cup thus formed will stop leakage if wiped out from time to time.

REMOVING OLD CALCIMINE

I recently purchased an old New England farmhouse, which I wish to remodel for a summer home. The interior walls, while sound, are covered with calcimine or whitewash, but I want to give them an eggshell oil-paint treatment. How should they be prepared?

This work is best done by two people, one of whom uses a pail of warm water containing a cup of vinegar to sponge and wet the surface thoroughly. The second person follows within a few minutes and uses a palmetto brush and a pail of water containing one cup of trisodium-phosphate powder to loosen and wash off all traces of whitewash. A wide putty knife may prove of value in speeding up the work. Let all surfaces dry with wide-open doors and windows.

Cut out any cracks or dents and repair

KEEP BRUSHES OUT OF WATER

Recently I read that many painters keep brushes soaking in water when not in use, but isn't this very harmful to the bristles?



Whoever wrote that ought to be fined \$50 or given six months in jail! Suspend occasionally used paintbrushes in a mixture of half pure turpentine and half pure raw linseed oil so that the bristles remain straight and hang clear of the bottom of the container by at least 1". Wipe such brushes dry before using. They will keep in perfect condition. Water, on the other hand, makes the bristles soft and flabby.

PAINTING RESINOUS WOOD

Here in the south we have trouble with pine resin streaks showing up on our outside trim. The paint cracks like an alligator's skin and is now peeling off. How can I cure this?



Have a reputable painter burn off the broken-down coats after you have obtained written permission from your fire insurance company to do this work. Without this permit you take a chance on having all your fire insurance invalidated.

This burning is necessary, first, to remove the old paint, and second, to draw out the excess resin from the wood. Sand the trim. Prime with aluminum bronze of the varnish grade, using 2 lb. of bronze in 1 gal. of outside spar varnish. Wet the bronze to a paste with turpentine before adding the varnish. Brush out well, dry hard, and then give two coats of first-quality paint. Sand the first coat lightly when dry.

with patching plaster. Dry hard and cut down with No. ½ abrasive paper until level and smooth. Then proceed to use the eggshell wall paint according to the manufacturer's directions.

PRESERVING COPPER SCREENS

A previous tenant painted our copper screens black. How can I get this off? We live near the seashore, so what should I do to keep the copper from turning green?

Lay the screen down over a sheet of metal or any building board that has been given a coat of hot paraffin to stop absorption. Use a heavy bodied or marine-type varnish remover on the screen wire. Apply with a slow, flowing motion in one direction only;



WATER USED FOR FINAL RUB

Why do you use wet cotton waste for a final rub after crude oil and pumice stone?

The use of clean, white cotton waste or a piece of wrung-out cotton flannel to clean up and polish after oil rubbing is a long-established practice in the coffin industry. This method produces a rich, semipolished sheen not obtainable in other ways and removes any "stop marks" left by the felt rubbing pad. Rubbing pads used with oil should never be used afterward with water or they will become hard and glazed. If that should happen, soak the pad overnight in gasoline and clean with a dry scrub brush.

let stand ten minutes, test with the finger to see if the finish is cut down to the wire; then scrub loose with an ordinary palmetto brush. The wire must press against the backing material throughout because copper or bronze mesh is too soft to stand unsupported pressure.

Turn the screen over and repeat the process very carefully to prevent springing the wire. Give a final wash with another scrub brush and denatured alcohol. Clean up the frames as well. Let dry overnight, then give a light brushing, from both faces, of outside spar varnish. Blow out any places where the varnish has bridged the meshes. The metal will not be corroded by salt air.

PREPARING A PLASTER WALL

We are planning to wall-paper several rooms in our new home, but have been warned that the plaster may be too fresh and that this might cause discoloration or other trouble later on. Is there any way to test the plaster?

Before wall paper is hung on a plaster wall it is important that the plaster be in good condition without "hot spots" caused by excessive lime. If in doubt, apply a five-percent solution of phenol-phthalein, which can be obtained at a drug store. If this chemical causes a stain to appear, ranging in color from pink to deep red, the plaster requires to be neutralized before any paper can be safely hung. This can be done by using a solution of from 2 to 4 lb. zinc sulphate to a gallon of hot water.

After the wall has dried it must be properly sized. In case the plaster was found to have an excessive amount of lime or is otherwise in doubtful shape, it is best to prepare a special size as follows: eight parts ordinary commercial wall-paper size or glue size, one part molasses, and one part vinegar. Heat, stir well, and apply to the wall while hot. Another point to remember is that whenever a high-grade, expensive paper is used it pays to apply a lining paper first.

RICH STAIN FOR MAHOGANY

How can I give a Colonial mahogany finish to a table I have made?

Usually this is a deep mahogany color of rich, reddish tinge. First stain the wood brown mahogany, let dry, and rub with 6/0 garnet finishing paper; then apply a coat of red mahogany stain. Fill the grain with paste filler tinted red mahogany. Apply one coat of high-grade four-hour floor varnish thinned with an equal amount of turpentine, and follow with two or three coats of full-body varnish. Rub to a semipolish with FFF pumice stone and oil.

REMOVING PAINT FROM GLASS

What is the easiest way to remove a painted sign from a window?

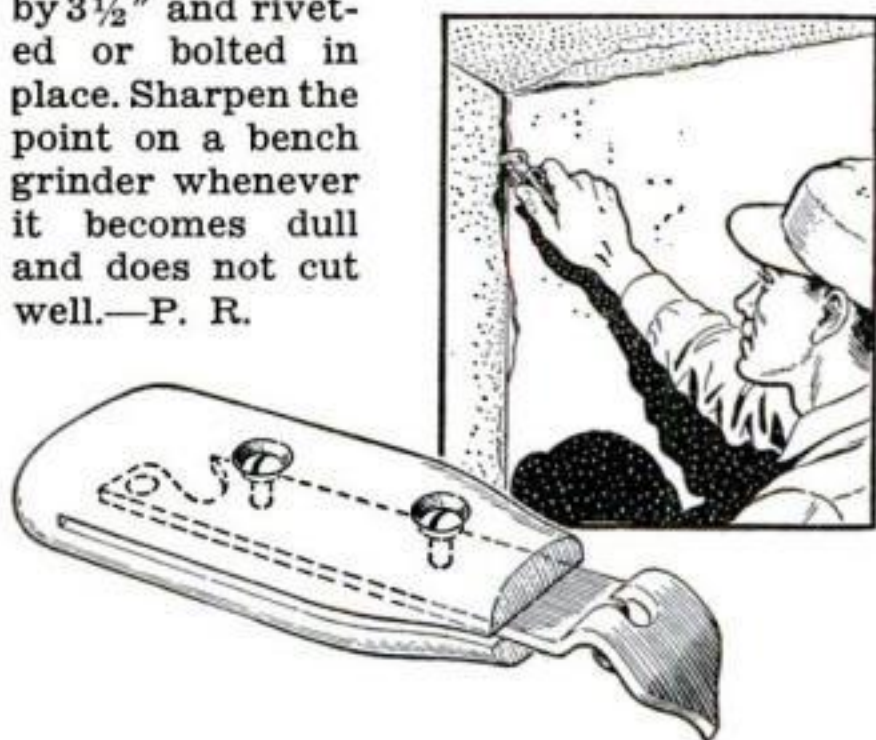
Make up a paste of 1 lb. of ordinary whitening and a small quantity of water containing all the washing soda it will dissolve. Apply this paste freely to the painted letters on the window. Leave it on until the letters are quite soft and can be cleaned off with a wad or roll of newspaper.

Emergency Work Flag Set Up on Shovel

"WARNING" or "stop" flags are easily carried on construction jobs for emergency use if made as shown. Short sections of radiator hose, slit open at one side, are attached to the crosspiece and tip of the flag. These grip the handle of a long-handled shovel, which may be stuck into the ground to serve as the supporting staff.—G. H.

Tool for Cleaning Out Cracks in Plaster

BEFORE patching long, narrow cracks in plaster walls such as those that often occur in the corners of a room or along the base-board, it is necessary to widen them, clean them out thoroughly, and undercut the edges a little. This can be done quickly and easily with a crack-opening tool made as shown below from an ordinary beer-can opener. The handle is shaped from a soft pine block about $\frac{3}{4}$ " by $1\frac{1}{2}$ " by $3\frac{1}{2}$ " and riveted or bolted in place. Sharpen the point on a bench grinder whenever it becomes dull and does not cut well.—P. R.



A wooden handle is bolted to a beer-can opener



The flag is held with pieces of radiator hose

Removing Stamps Quickly

STAMP collectors can remove stamps almost instantly from envelopes without running any risk of damaging them by placing several drops of water so as to form a little pool over the entire surface of the stamp and then heating the water with an electric burning or pyrographic pen. This quickly softens the mucilage, and the stamp comes off.



Casein-and-Whiting Cement Fastens Small Handles

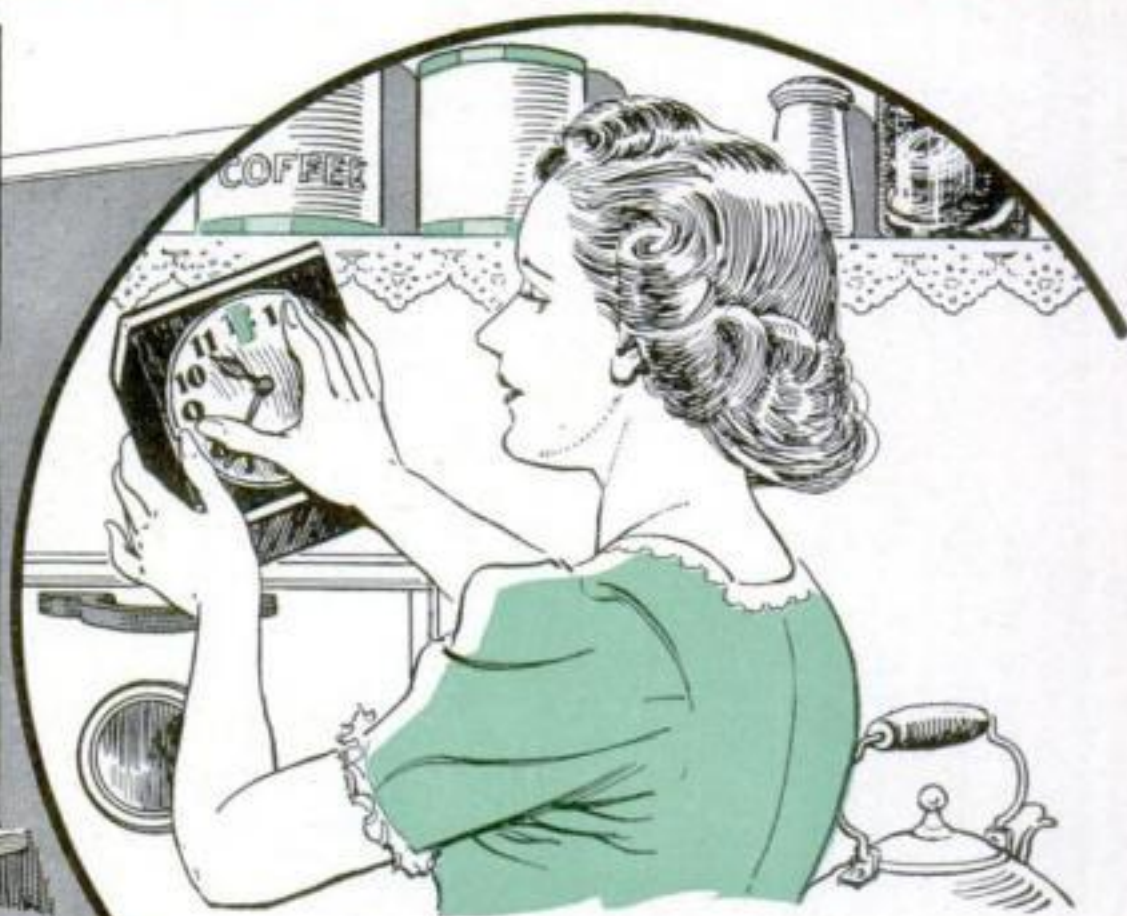
WHEN a knife, tool, or other small implement must be replaced in its handle, a satisfactory and easily prepared cement consists of one part each of waterproof casein glue and whiting. The glue gives the compound an adhesive and waterproof character, while the whiting provides bulk and lessens the tendency to shrink.—O. B.

• • •

IF YOU standardize on 12" hack-saw blades of the hand style and make a habit of using the forward 6" until worn, then the remainder of the blade, you will get much longer life out of each blade.

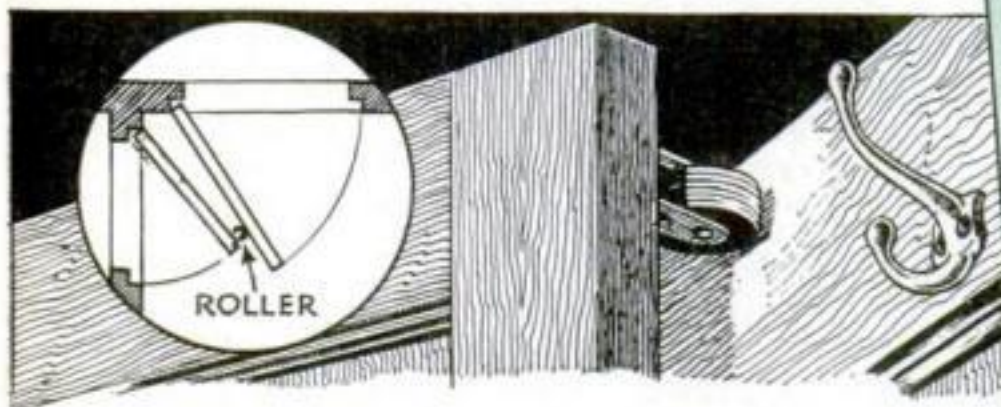


KEEPING THE



As a reminder of when the cake will be done, fasten a piece of tape or gummed paper on the glass front of the kitchen clock and rotate the glass forward the required minutes

To use an electric fan as a kitchen ventilator, set a plywood panel with a hole 1" larger than the fan diameter between the window trim and a cleat on the shelf. A catch holds the panel at the top



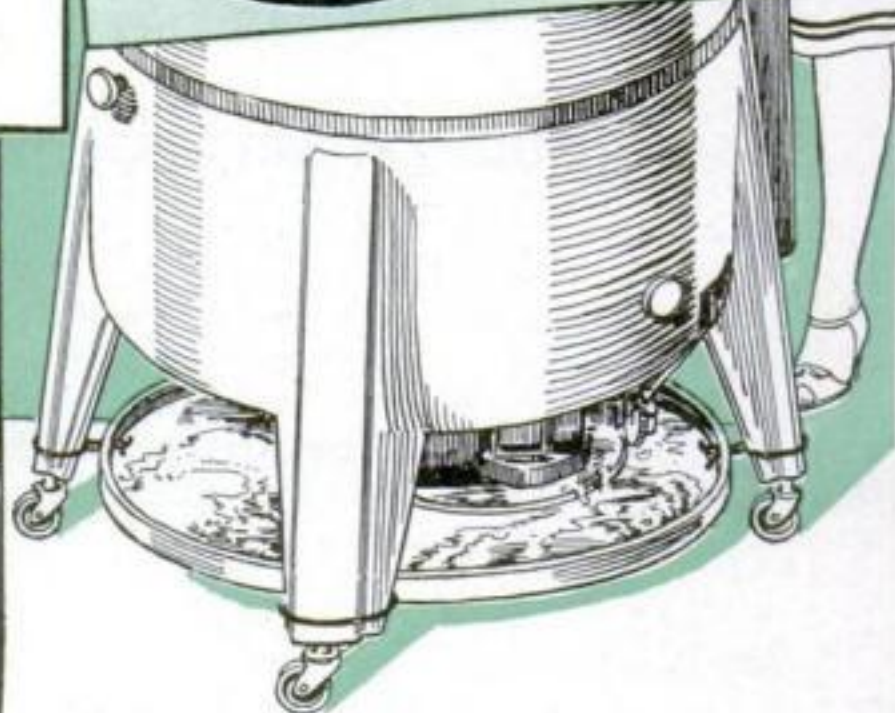
When two doors open against each other, a small rubber wheel attached to the top corner of one door prevents the knobs from scraping the panels



Cellulose-base linoleum cement can be prevented from drying and cracking after it is applied by adding $\frac{1}{2}$ oz. castor oil to 1 qt. cement. Even after it has dried, it may be bent like celluloid

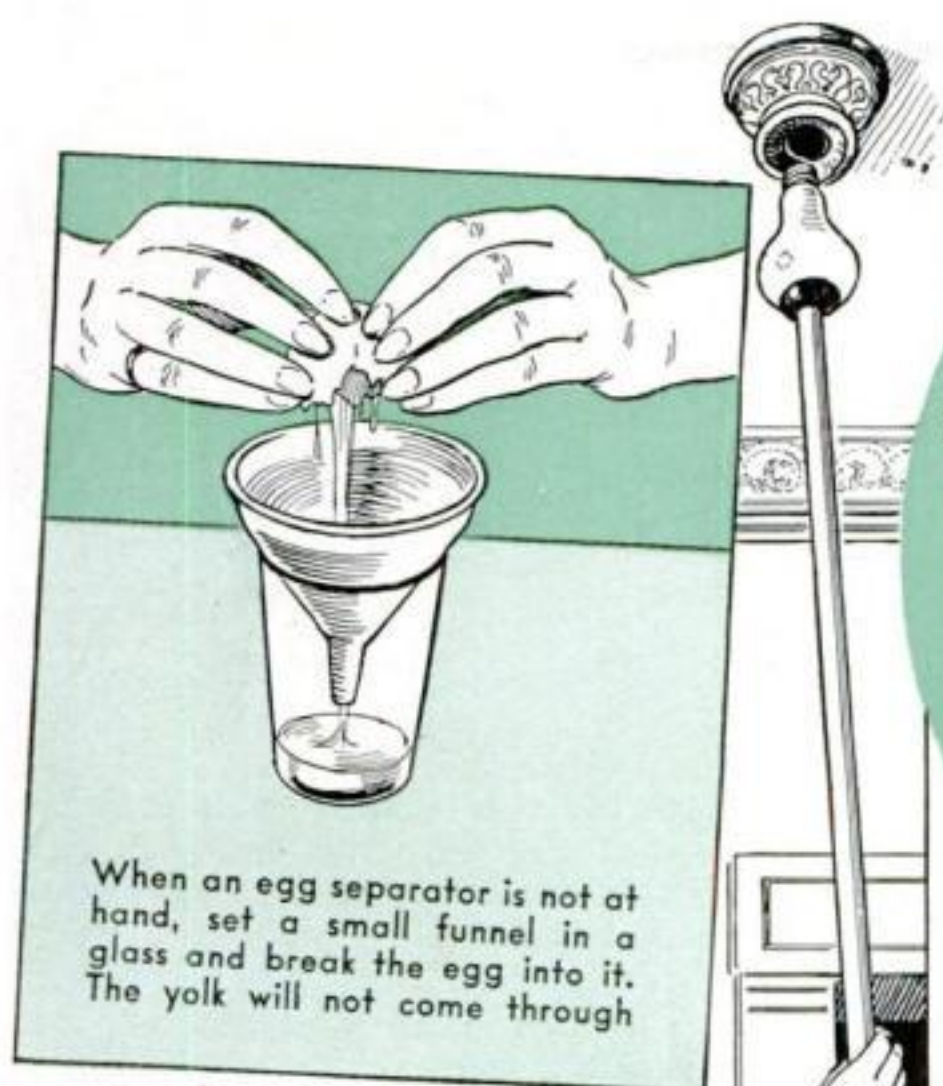


A spring clothespin makes an excellent clamp for a tubular-type candy thermometer. Wet the twine before wrapping around clamp and tube



If oil occasionally drips on the floor from the motor of your electric washer, wire the metal lid from a large pretzel or lard can to the legs

HOME SHIPSHAPE



Bulbs in high ceiling fixtures can be removed with a suction cup attached to a pole. Wet the cup and then press against the bulb firmly.



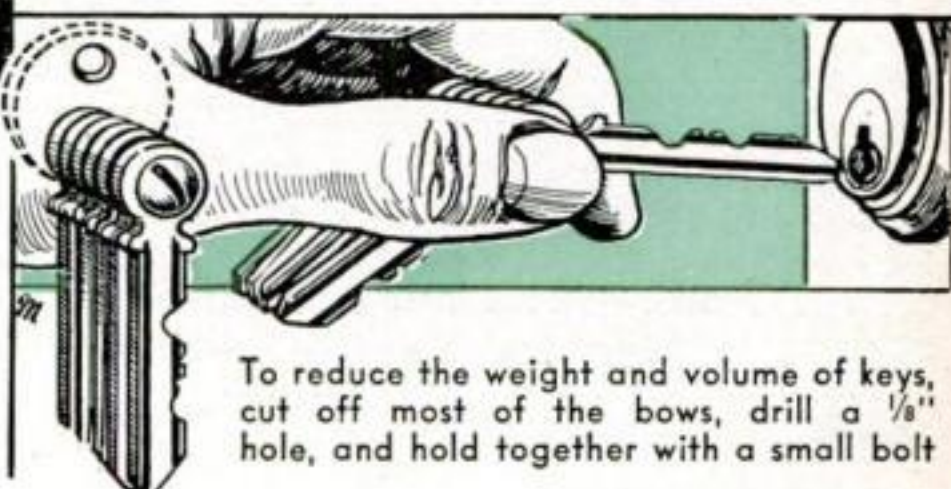
Powdered graphite obtained from the lead of an ordinary pencil makes a good lock lubricant. It may be blown in if no ejector is available.



For mixing paste white lead to make paint, this paddle is ideal because lumps are broken easily. Bore the holes before cutting the paddle to shape.

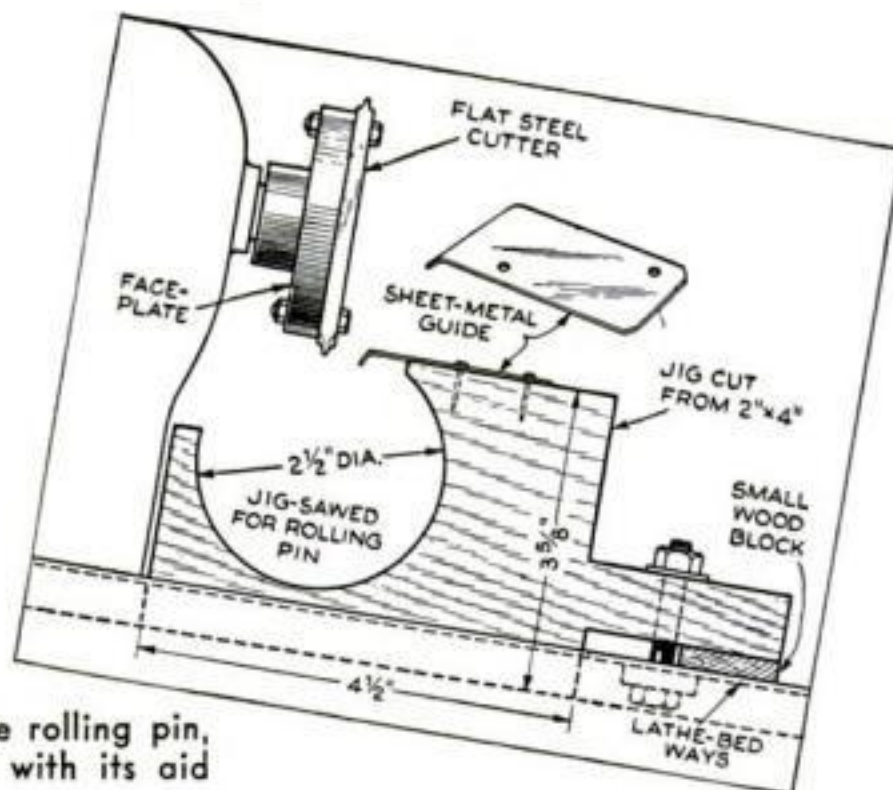
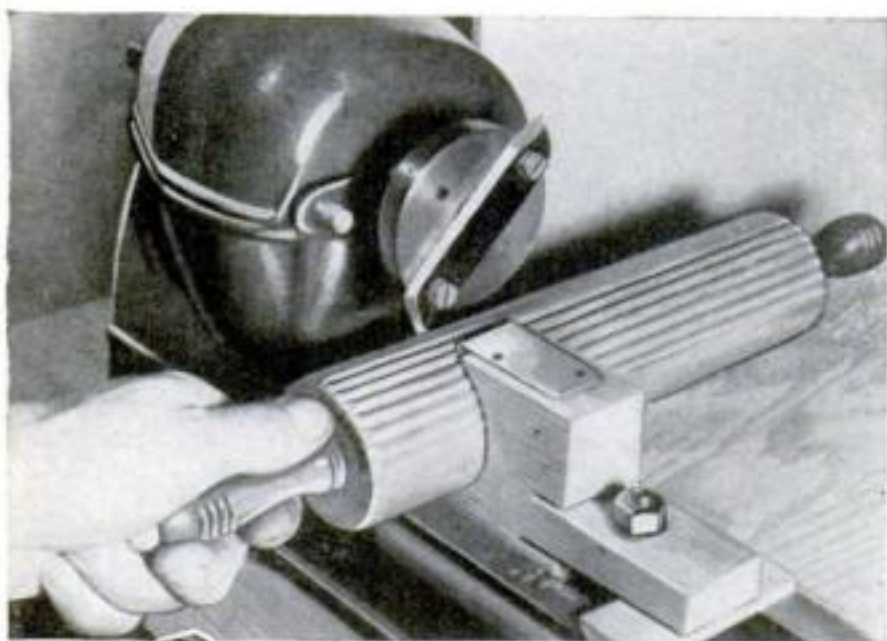


Precious stones can be cleaned with tooth paste. Apply the paste (any popular brand) with an old toothbrush and rinse the stone in running water.



To reduce the weight and volume of keys, cut off most of the bows, drill a $\frac{1}{8}$ " hole, and hold together with a small bolt.

Fluted Pin Rolls Fancy Cookies



How the flutes are cut in the rolling pin, and, left, cookies prepared with its aid

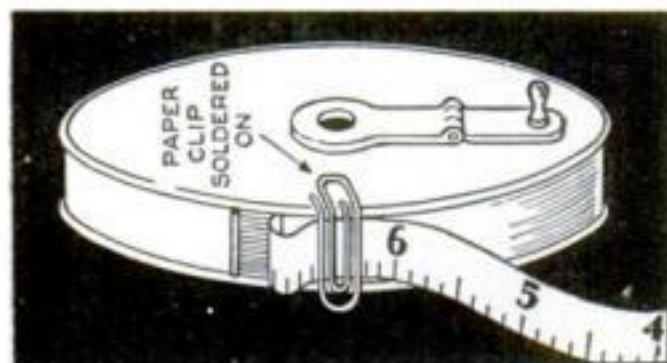


FANCY cookies are easily prepared with a fluted rolling pin. The one shown is an ordinary rolling pin, $2\frac{1}{2}$ " in diameter, which was fluted with a cutter made from a piece of flat steel $3\frac{3}{4}$ " by $\frac{3}{4}$ " by $\frac{1}{4}$ ". The ends were ground to the shape shown, and the cutter was mounted on the faceplate of the lathe. A jig to hold the rolling pin in position under the cutter was cut from a piece of 2" by 4"

stock. Note the sheet-metal guide attached to the top of the jig. One end was bent over so it would fit in a groove already made and assure even spacing.

A line was marked along the pin for the first groove. The lathe was started, and the pin pulled forward slowly as the cutter ploughed out the groove. The other grooves were automatically spaced by the sheet-metal guide.

For best results in making cookies, a very short dough with little or no leavening should be used.—BENJAMIN NIELSEN.



Clip Keeps Tape from Unwinding

TO APPLY a restricting brake on your tape line and prevent it from unwinding too easily and tangling, bend a wire paper clip at a right angle and solder it on the side of the reel box. It is an easy matter to slip the tape under the clip and hold it at any desired length.

Foolproof Length Gauge Clamps on Yardstick

FOR marking lengths or transferring measurements when cutting wood stock, I find it easier, faster, and more accurate to use the sliding indicator illustrated. It is a common spring paper clip to which a slender brad has been soldered. The indicator can be clamped over a yardstick or any thin strip of wood. Three or four of the clips may be set along a rule or stick when you wish to record several measurements. Where inside measurements have to be made and you must telescope two shorter sticks, these form handy non-slip clamps.—RALPH C. COX.



Repeated measurements are marked quickly with the aid of the indicator

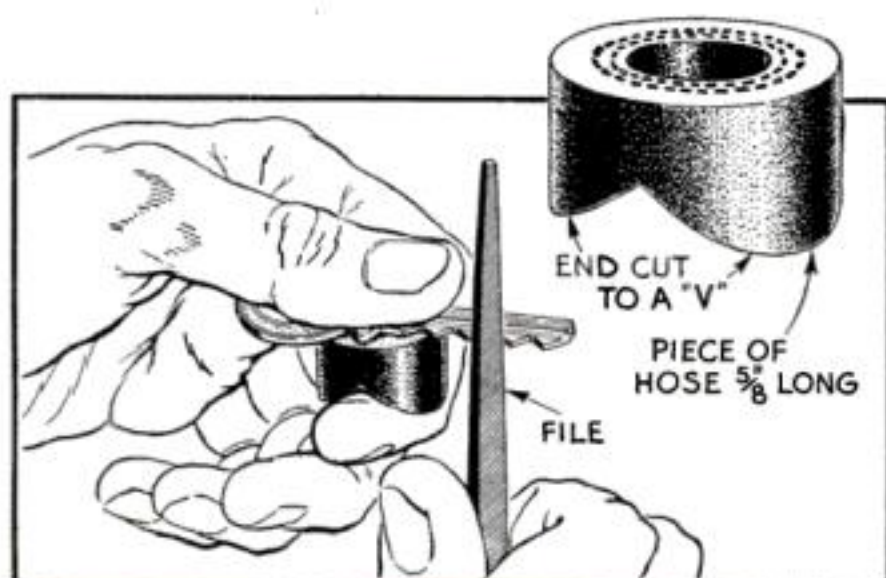
Arms of Easy Chair Re-Covered with Cloth Taken from Back

WHEN the cover material on the upholstered arms of your favorite armchair has worn through while the rest of the chair remains in good condition, you do not necessarily have to go to the expense of re-covering the entire chair. Almost always, the rear of the chair back is covered with a large panel of the same material, and this is enough to re-cover both arms.

First, a narrow fold is turned to provide a strong finished edge, which is fastened with gimp tacks along the outside under-edge of the arm roll. Next, turn the piece of cloth up, over, and down the inside surface of the arm. Carefully fold and fit it over the front end of the arm, and tack down along the rear outside edge of the vertical part of the arm. After the cloth has been pulled down smoothly, the lower inside edge is stitched to the original covering, and the back edge is tucked into the space where the arm meets the chair back.



A piece of cloth of suitable color is afterwards tacked on the chair back where the original cloth was removed.—H. O. BUMANN.



Short Section of Hose Used as Finger Vise

MANY small flat pieces that have to be shaped or finished by filing can be most conveniently held in the fingers with the aid of a section of air hose or heavy water hose about $\frac{5}{8}$ " long. Cut a V into one end of the tubing to fit over the tip of the forefinger, as shown above.—F. B.

Keeping Dial Phone in Place

DIAL telephones have an aggravating habit of slipping on a polished desk when you are dialing, thus turning a one-finger job into a two-handed one. Mine used to do this until I brushed a little paper cement (white rubber cement) on the felt on the bottom. Now the phone stands as if bolted to the desk.—E. C. BROWN.

Nails Stuck to Hammer for Starting

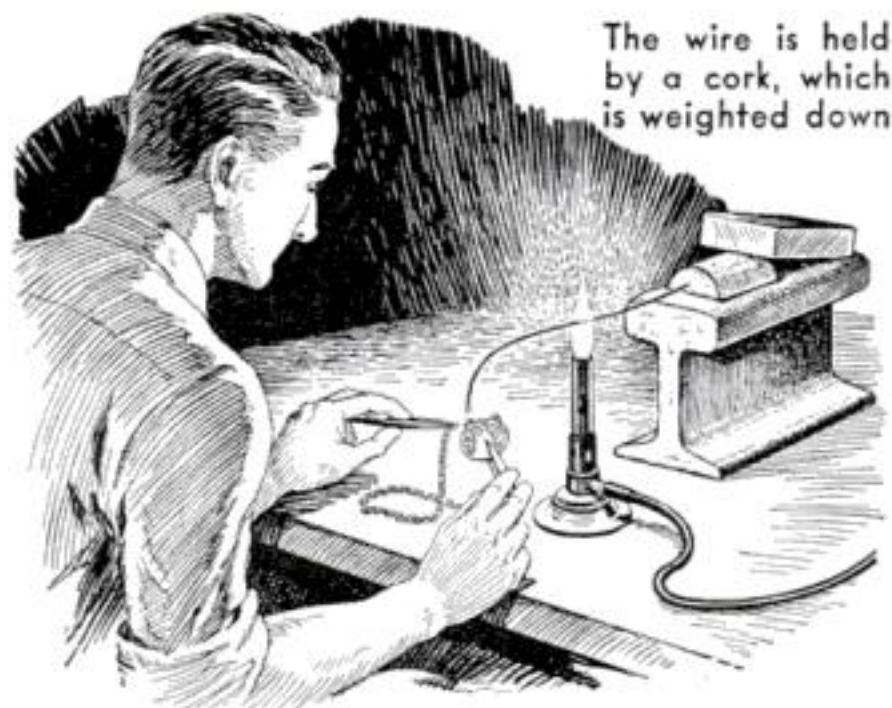
A GOOD trick for starting nails where it is inconvenient to hold them, is to rub a little belt dressing on the side of the hammer head. The nailhead adheres to this sufficiently to remain in place for the first blow, with the hammer held sideways.



Nail and Screw Holders



TO KEEP odds and ends of nails and screws at hand in a barn, garage, or workshop, cut the tops from a number of tobacco cans and nail these onto the side of any studding. Place the supporting nails somewhat above the middle of the cans. The contents are made accessible by tipping the cans forward.



Tiny Articles Soldered by Using Hot Wire

VERY small articles, such as tiny links of white-metal costume jewelry, can be soldered neatly with ordinary soft solder as shown above. The 14-gauge copper wire takes the place of a soldering iron, and the heat is regulated by moving the Bunsen burner. When the end of the wire is hot, soldering paste is applied and a warmed piece of wire solder is touched against it so as to leave enough for joining the parts.—F. D. M.



Percolator Serves as a Gluepot

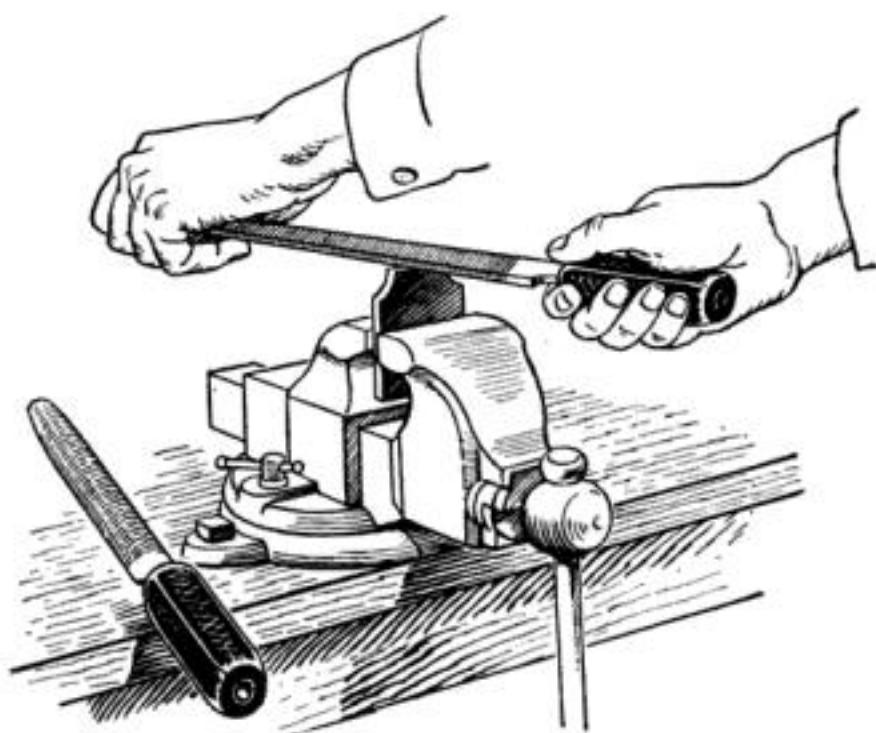
A DISCARDED electric coffee percolator can be used as an electric gluepot. Place the inner part of an ordinary gluepot in the open top of the percolator to hold the glue. The water heats it quickly.

Repairing Rusted Feet of Old Laundry Tubs

WHEN the angle-iron legs of laundry tubs rust away at the base, scrape all the scale off, place a conical sheet metal mold around the leg, clamp it shut, and fill with molten lead as at the right. Then strip off the mold. In some cases it may be necessary to drill holes in each of the tub legs to provide a strong key for the lead.—HOWARD LEWIS.

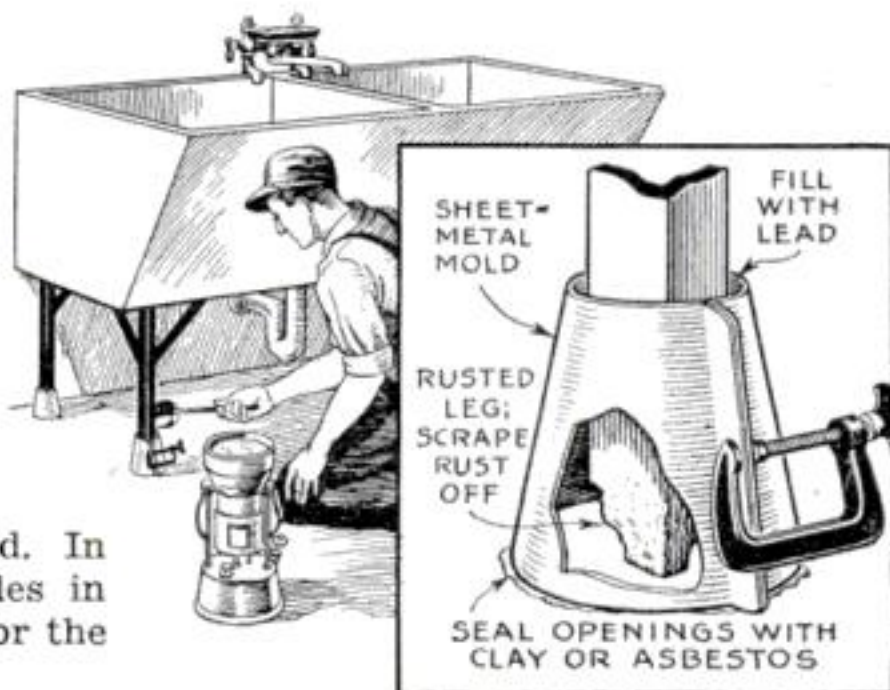
Putty Knife Is Altered for Scraping Cans

REMOVING the contents of the common type of small paint can or any can having an edge turning inward will be easier if you cut or file away part of an ordinary putty knife near the handle as shown in the sketch above. The knife reaches into every corner. It is also a handy implement for mixing the can's contents.—STAN HUGO.



Rubber Handles Improve Files

RUBBER bicycle-pedal treads, obtainable from a bicycle supply store or taken from an old bicycle pedal, make excellent file handles that will not come off in use, yet can readily be removed. The rubber is sufficiently flexible so that the file can be held easily in unhandy places and is less tiresome to grip.—KOU DY KENNON.





By
HI SIBLEY

These fine goggles were made by a Hawaiian. Experts consider this type more satisfactory for serious diving and continuous use than the ordinary rubber variety

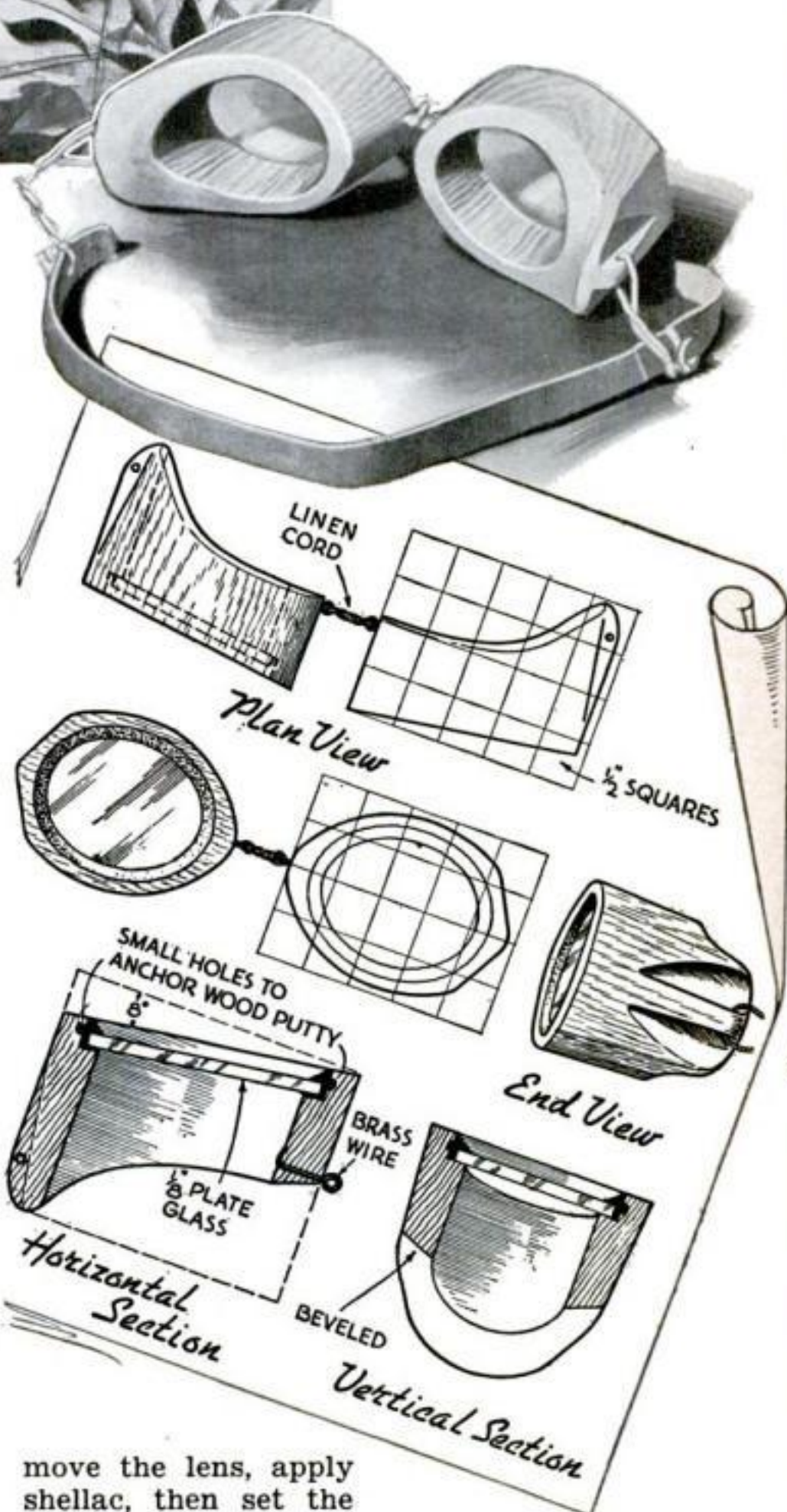
SOUTH-SEA Diving Goggles

WITH a little care and patience, you can construct diving goggles exactly like those used by the spear fishermen of the South Seas and expert Hawaiian divers.

Any nonporous hardwood not likely to split may be used, but it must be thoroughly seasoned. The goggles shown in the photographs were carved from "hau" (pronounced "how"), a wood available in Hawaii.

Cut two blocks 2" by 2" by 2½", and bevel the front surface of each on an angle of about 8 deg. Then bore and file out the openings as shown. Carve a rabbet or seat for the lenses, which are plain plate glass about ⅛" thick. Any glazier will cut these for you. In making the seat, try to get as perfect a fit as possible. By coating the lens with lampblack and pressing down on the seat, high spots will be revealed. Do not mount the lenses until the outside of the wood is shaped to its final form, and the small brass eyes for the cord have been inserted in their holes and clinched inside.

Apply shellac on the lens seat, then a thin layer of plastic composition wood. Press down with the lens to smooth the paste. Re-

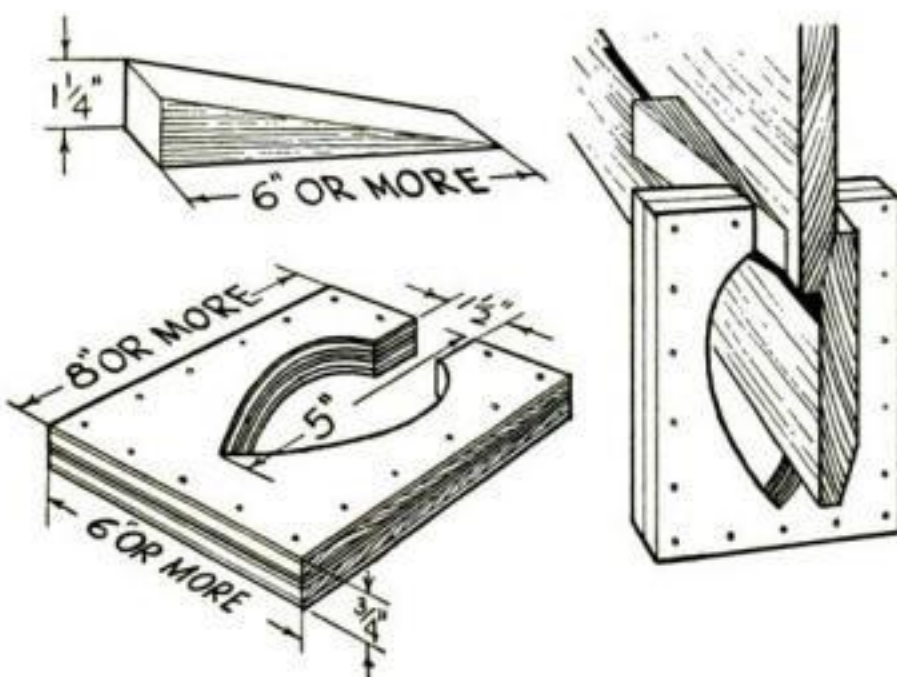


move the lens, apply shellac, then set the lens permanently. Clamp or put weights on the lens to hold it firmly until the shellac dries. Finally, apply composition wood around the edges on top, as shown. If

small, shallow holes are first drilled around the inside, they will serve to anchor the plastic material more firmly.

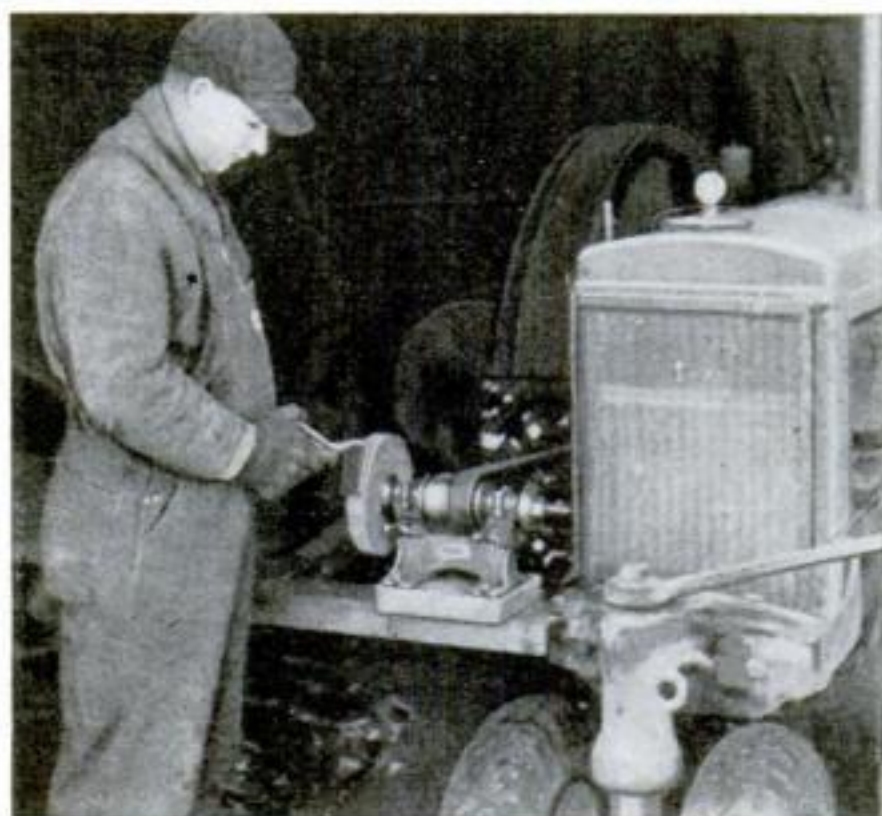
The rim that fits around the eye should be beveled carefully so that the pressure will be equal all around. The flesh will yield enough, if the wood is properly fitted, to form a watertight joint. Give the wood two or three coats of shellac all over.

To prevent fogging in use, soak the goggles in water of the same temperature as that in which they are to be used. Wet the skin around the eyes and press the goggles on to create a partial vacuum inside. This will make the eyes feel a bit queer, but does not hurt. The proper spacing of the two members can be determined by experiment.



Boat-Planking Clamps

IF YOU do not have enough large screw clamps to hold the planks while fitting and riveting a small lapstreak boat, make up a dozen wedge clamps from two layers of $\frac{3}{8}$ " plywood as shown above. The inner portion of the jaws is sawed larger so the clamps can be used on curves.—J. W. RANKIN.



A fairly tight rubber band keeps the goggles on

Radiator Hose Used as Golf Practice Ball

A 2" PIECE of $1\frac{3}{4}$ " radiator hose may be used for practicing golf shots, either indoors or outdoors, with all clubs except the putter. When hit, it gives about the same feel as a golf ball, and it reacts to the way it is hit much as a regular ball does. A perfectly hit shot will make it fly true and straight, whereas a poorly hit one causes it either to hook or slice. If hit underneath, it pops up, and topping will make it skitter over the ground for some distance.—LOUIS R. JAFFEE.



Grinder Set on Tractor to Sharpen Farm Tools

ONE farmer attached a grinding wheel base to his tractor as shown at the left. This required but little more labor than squaring the end of a block of wood to fit one of the regular sockets provided for attaching cultivating equipment. Powered from the belt pulley of the tractor, the grinder is useful for putting mower knives, cultivator shovels, and plowshares in good condition, as well as for other odd jobs.—ROYCE M. ROATH.



Hikers' Lightweight Tent Pegs Cut from Bamboo Poles

HIKERS, canoeists, and cyclists who carry feather-weight shelter tents on their trips can make a very light yet surprisingly durable set of tent pegs from bamboo as shown in the drawing at left below.

A bamboo pole about $1\frac{1}{4}$ " in diameter is the best size to use. One can often be obtained from furniture stores, which receive them in shipments of rugs. Cut the pole into sections by sawing about $1\frac{1}{2}$ " above each joint; then split the sections in half. Start the notches below the joint with a saw, then cut them out with a knife; finally, taper the other end. If bamboo smaller than 1" is used, it is best not to split it, but to use the material in the full round at the head.

Each bamboo stake weighs but a few ounces and the whole set adds very little to the weight of the pack.—CARROLL E. BRADBERRY.



Shoes for the Beach Fashioned Out of Old Inner Tubes

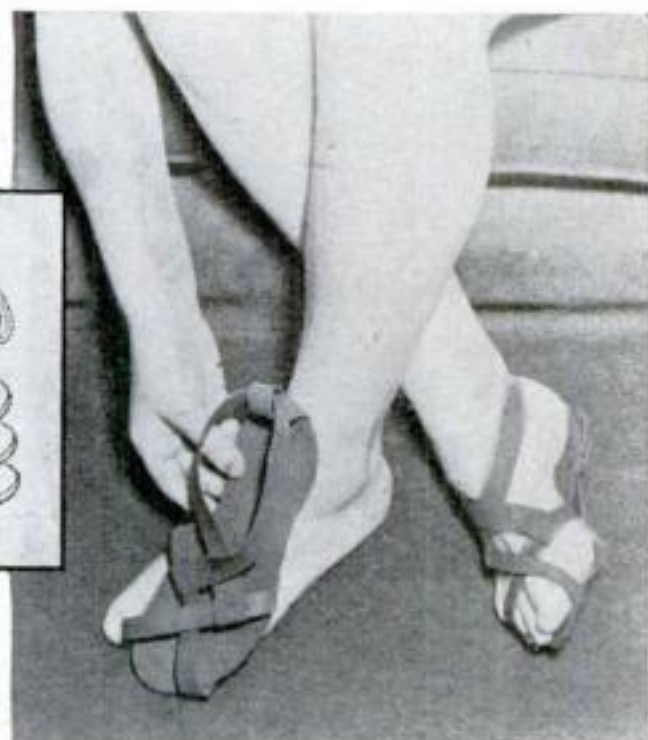
BATHING shoes for walking on scorching beach sand are easily made from a discarded automobile inner tube.

Draw the outline of each foot on cardboard and use it as a pattern in cutting the sole. Each sole is made of three thicknesses of rubber. The crosspieces are cemented in place with rubber cement after two thicknesses of the rubber sole have been cemented together. The length of the crosspieces is best determined by placing them across the foot in their position.

The back part of the shoe is anchored by cementing a short loop to the heel as shown.



Extra rubber cemented on the heel makes the shoes more comfortable for walking



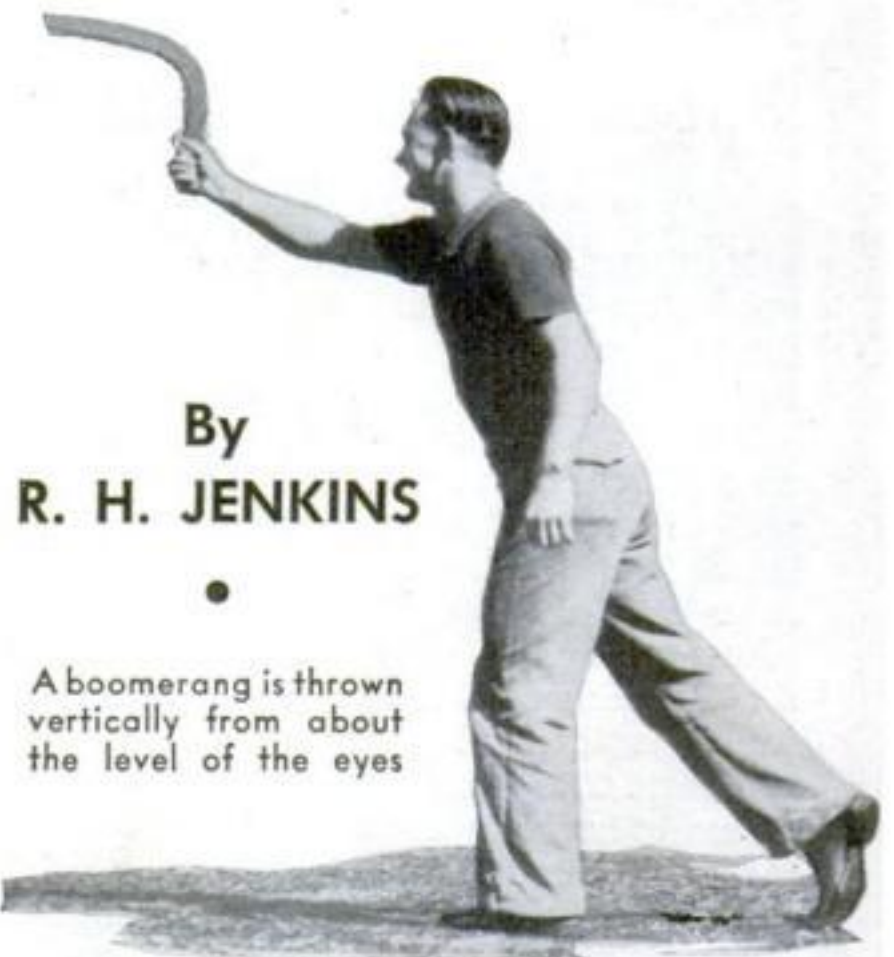
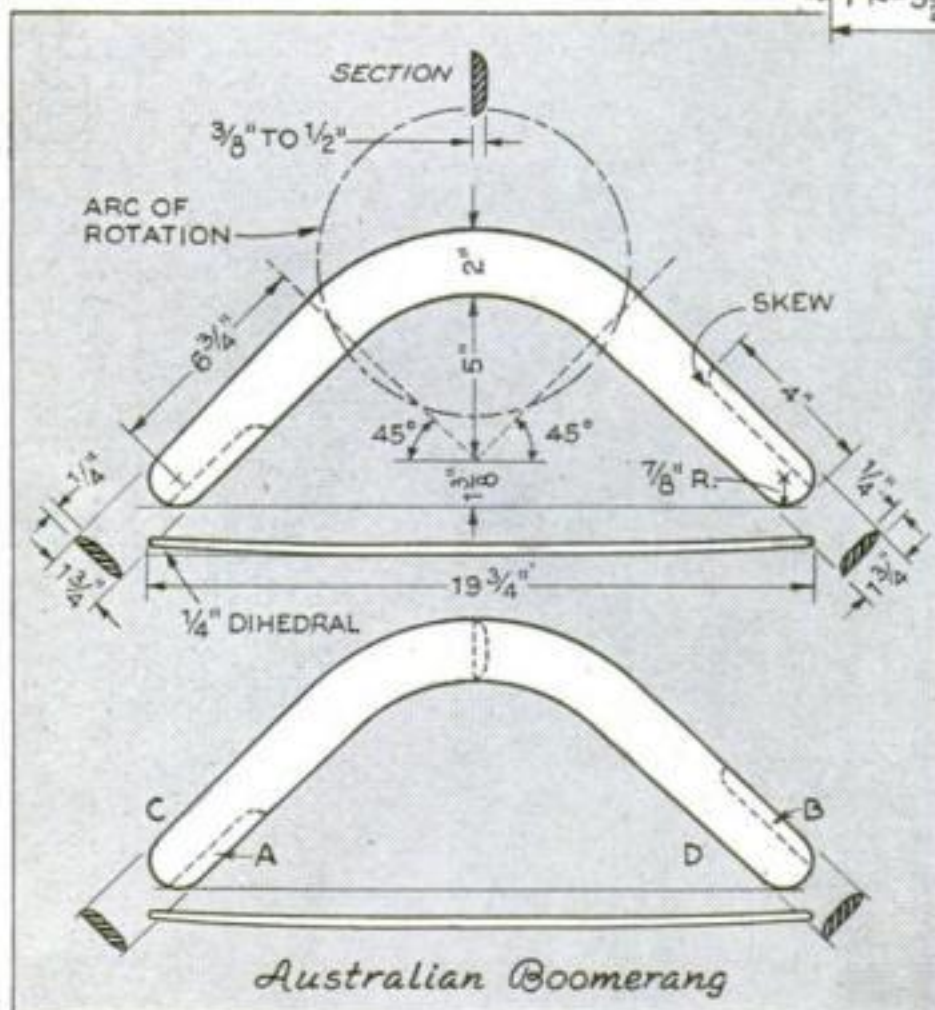
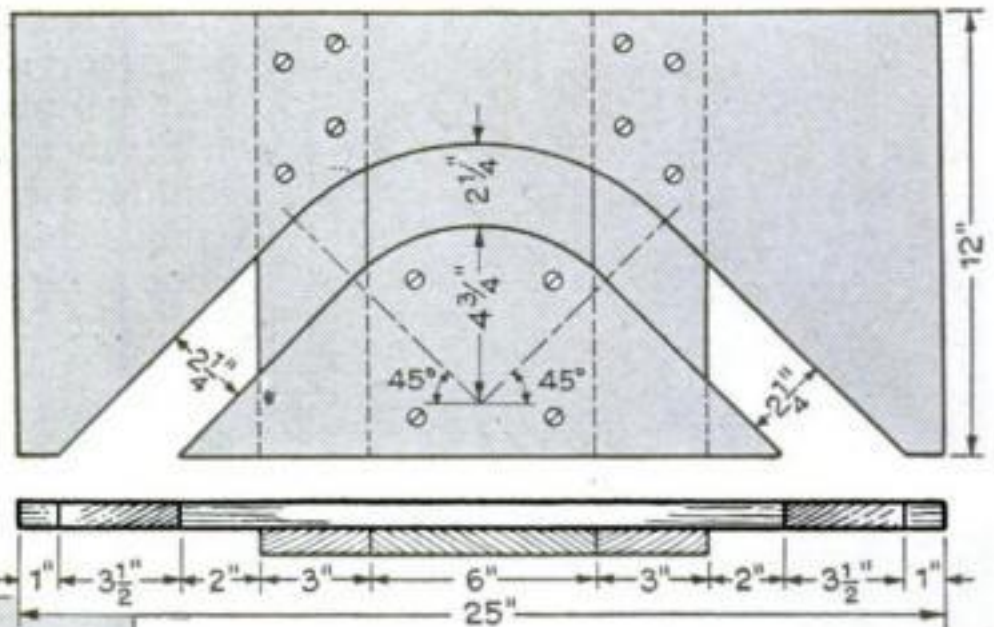
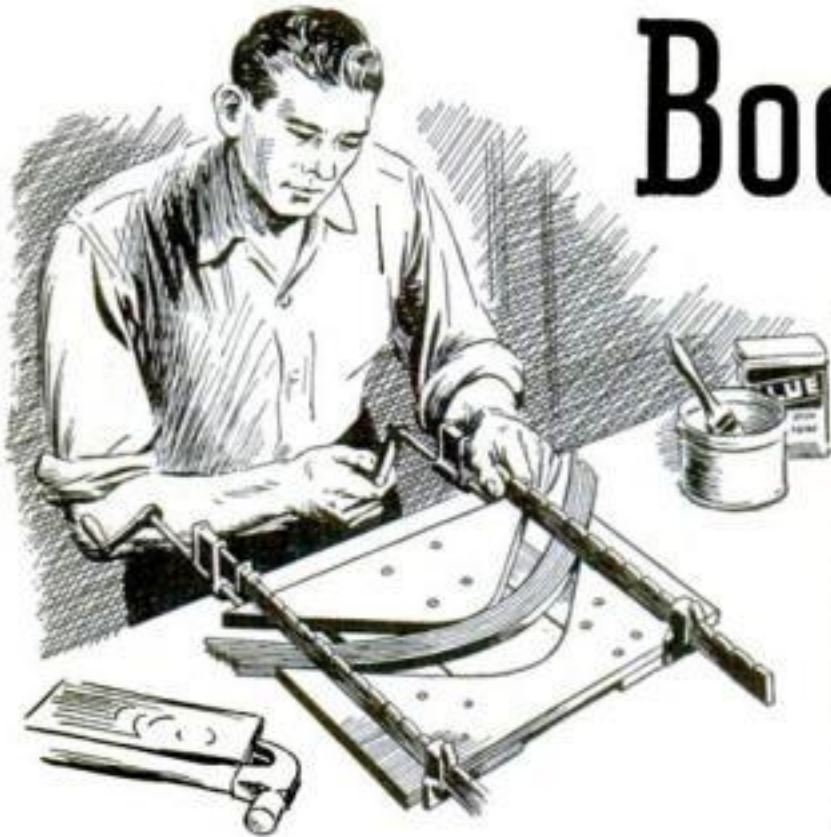
A rubber strap passes through this, crosses in front of the foot, and is attached to the crosspieces.—FRANK CAPORAEI.



Vine Awning Changes with the Seasons

WHEN the cloth on one of our awnings needed replacement, I covered the framework with $\frac{1}{4}$ " mesh hardware cloth and allowed a climbing vine to cover the screen completely. This awning may be called "automatic" because it changes with the seasons, growing dense in the summer and practically disappearing in the late fall when the leaves drop off. It does not, of course, have to be taken down.—A. J. VIKEN.

Boomerangs...How



By
R. H. JENKINS

A boomerang is thrown vertically from about the level of the eyes



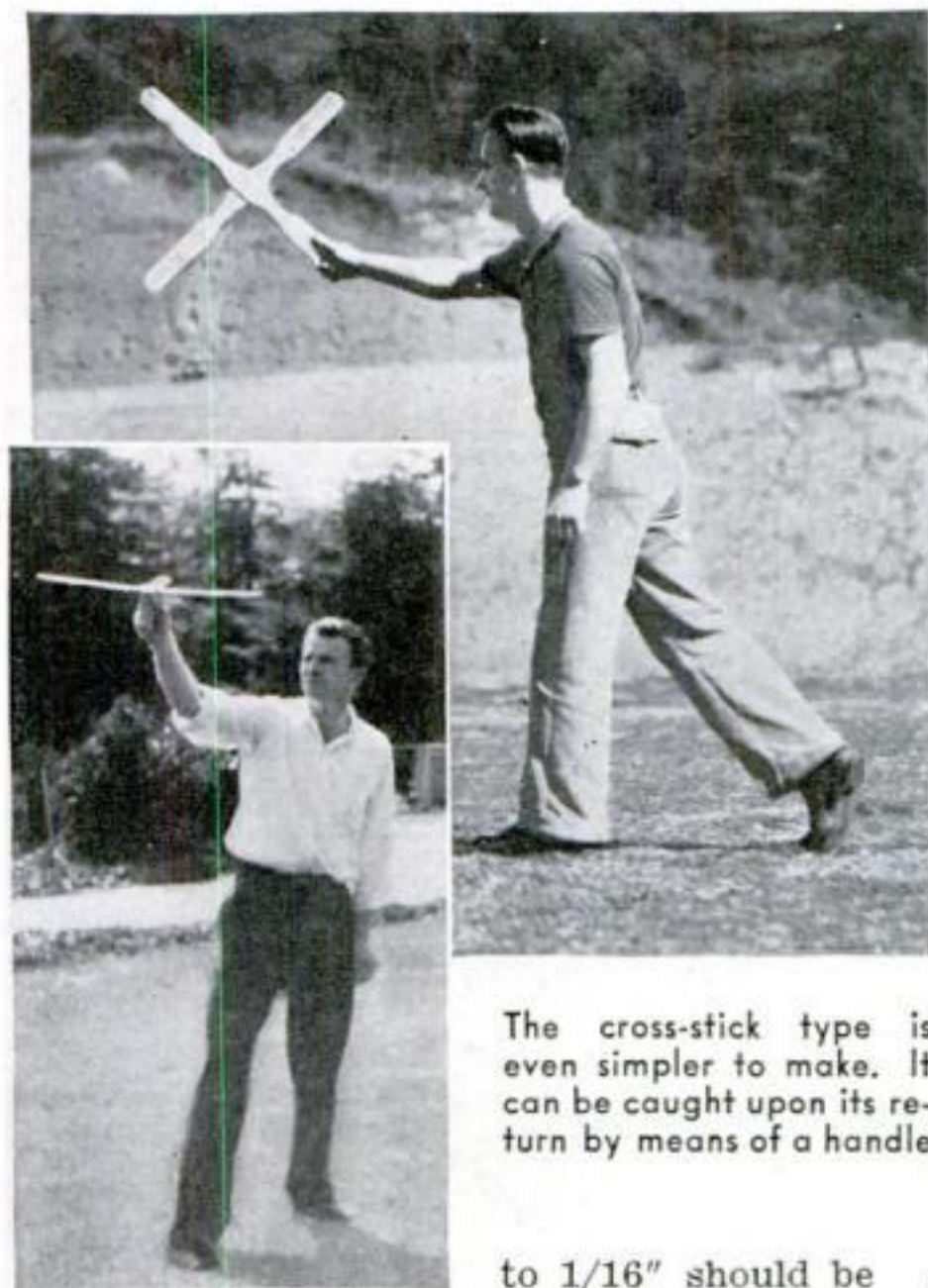
Flat and rounded sides of a boomerang made by gluing up thin strips in the jig shown at top of the page

IT'S GREAT sport to throw the Australian bushman type of boomerang, but its construction has always been a problem because of the difficulty of bending the wood. A simple solution is to glue up the boomerang from a number of layers of thin wood in a form or jig made as shown above.

Any wood will do for the jig, but be sure that the two curves are parallel when they are $2\frac{1}{2}$ " apart. For each boomerang cut eighteen pieces of oak or maple $\frac{1}{8}$ " by $\frac{5}{8}$ " by 28". Apply waterproof casein glue on each piece, clamp the whole mass in the jig, and let dry.

Plane the bottom smooth, cut out the shape, and round off the top to about $\frac{1}{2}$ " maximum thickness in the middle and $\frac{1}{4}$ " at each end. Bend up both ends by heating the laminated wood on top at the $6\frac{3}{4}$ " points and bending toward the heat; this gives the required dihedral angle or upward bend of about $\frac{1}{4}$ ". Skew off with a spokeshave the points marked A and B—from $\frac{1}{32}$ "

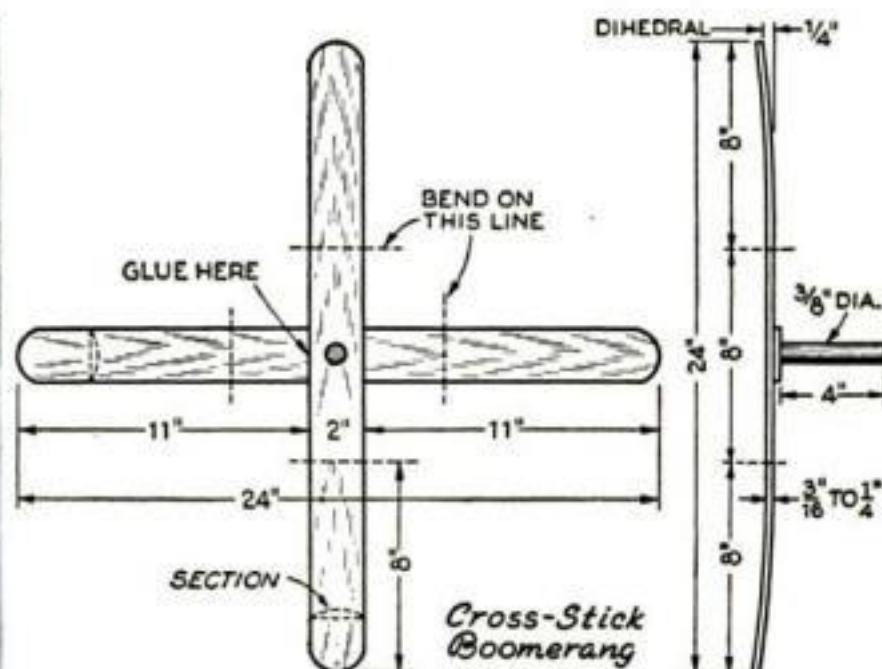
to Make and Throw Them



The cross-stick type is even simpler to make. It can be caught upon its return by means of a handle

to 1/16" should be enough. For a left-handed person, the points must be reversed and the corners taken off are then at C and D.

Throw vertically, never horizontally, and at about the level of the eyes. Hold the boomerang at end B unless you are left-handed, in which case hold it at end C. Be



sure to keep the curved face in toward your body. The throwing should be on soft ground.

The cross-stick type of boomerang is still easier to make. Rip out two strips 3/16" or 1/4" by 2" by 24". Find the center and glue together into a perfect cross. With the spokeshave, round off the top of each segment, working it thin on the edges but leaving the middle flat. Round off the ends, and bend up to get the dihedral angle from a point about two thirds of the distance from the end to the middle.

A 3/8" dowel, 4 1/2" long, may be used in the middle, but not glued, as an aid in catching the cross-stick boomerang. Don't attempt to catch the other type.

The first boomerang described could be made of alternate strips of mahogany and maple to give an inlaid effect, if desired.

Swing Holds Up End of Heavy Sand-Sifting Screen



While being filled, the screen rests on the barrow. Sifting is done as at right

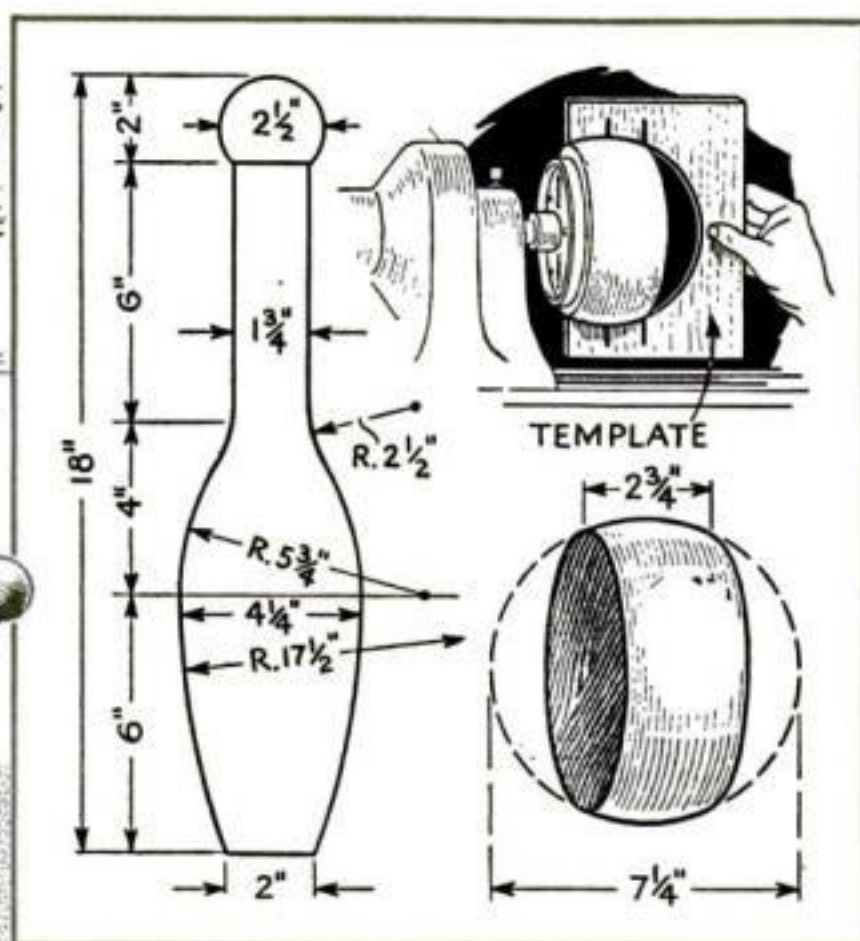
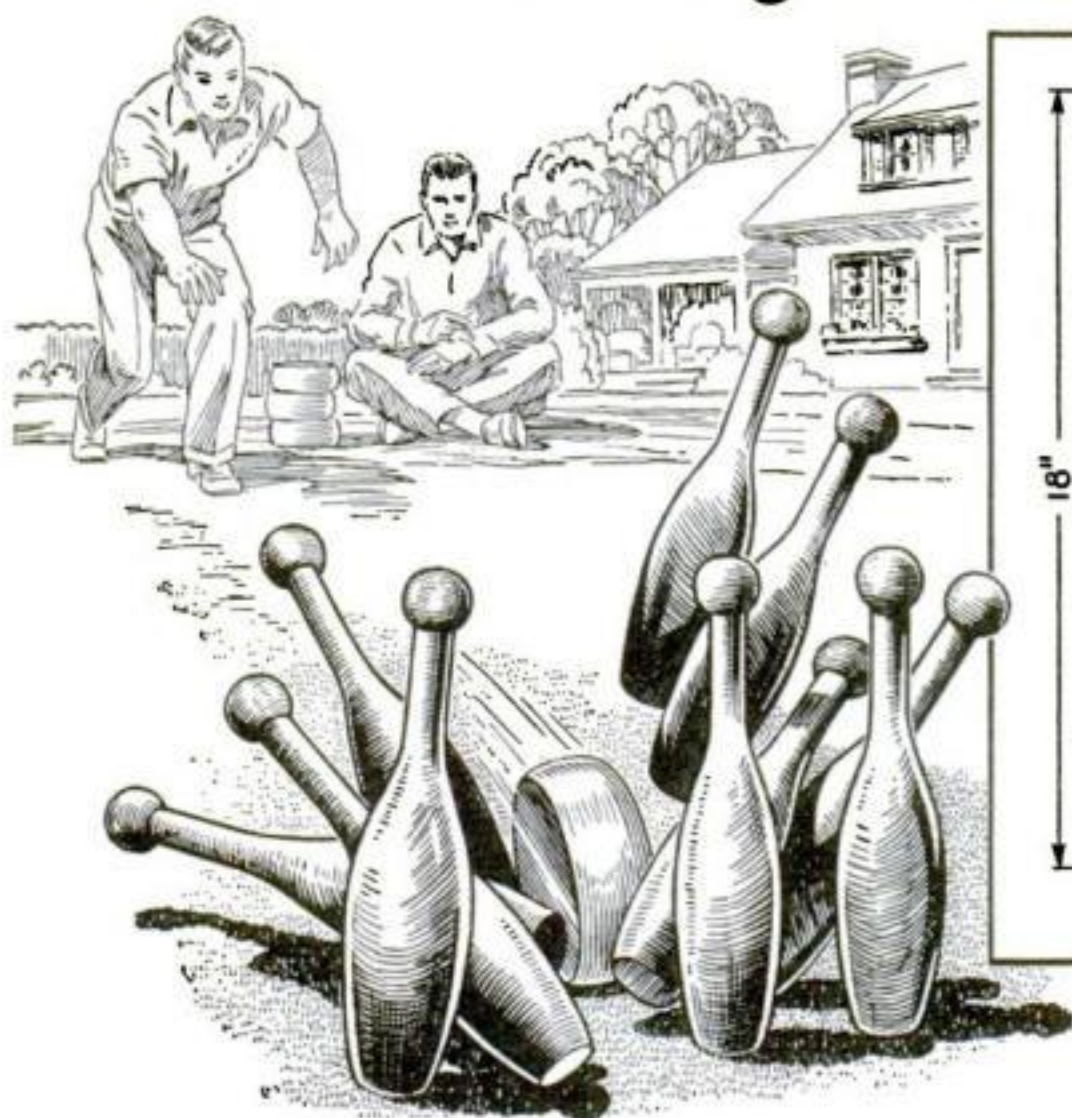
SAND and gravel can be easily screened by one person with a regular two-man screen if one set of handles is placed in a child's swing as shown.



While the screen is being loaded, the other end may be placed on anything of convenient height, such as the front edge of a wheelbarrow. The coarse material left on the wire mesh can be emptied into the wheelbarrow by up-ending the screen.

—J. D. STAGGS.

Lawn Bowling with Wooden Disks



In turning the disks, a template of $7\frac{1}{4}$ " diameter is used to test the crown. Pins can be turned to about the size given

THIS improvised bowling set, which can be made in an evening or two, can be used on either a well-mown lawn or a smooth basement floor. It provides an inexpensive way to enjoy the sport of bowling.

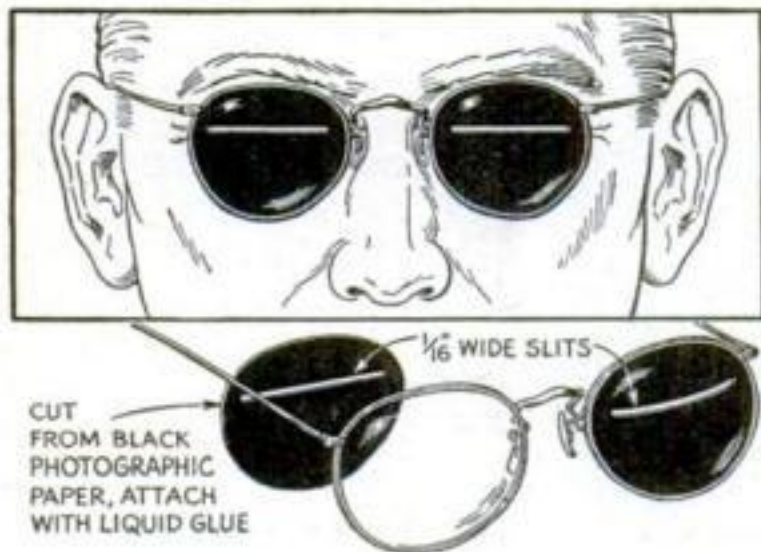
If a number of old Indian clubs can be obtained, they will serve as the pins. Sometimes discarded clubs can be picked up for little or nothing at a gymnasium. As a rule, however, it will be necessary to turn the pins on a lathe. They can be turned to about the size and shape shown in an accompanying drawing, but the dimensions may be changed, if necessary, to fit the available material. Hardwood is better for the work, but soft may be used.



For bowling at home, the disks are an inexpensive substitute for balls

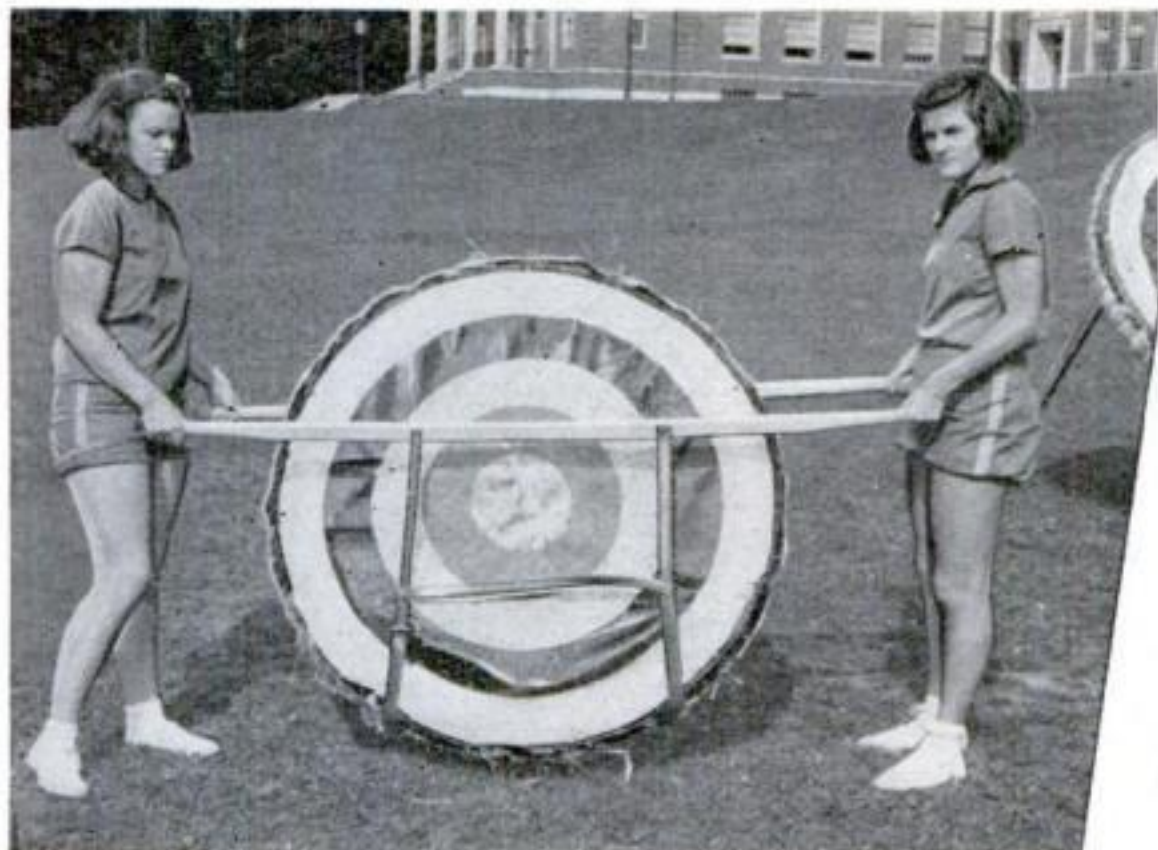
Each "ball" is made from a disk cut from 3" by 8" stock. The edges are turned to form a circular arc just as though each piece represented a part of a real ball. A template should be cut from thin wood to test the accuracy of the turning.

The bowling may be done with ten pins, or played like the regular game of "bowling on the green."—R. J.



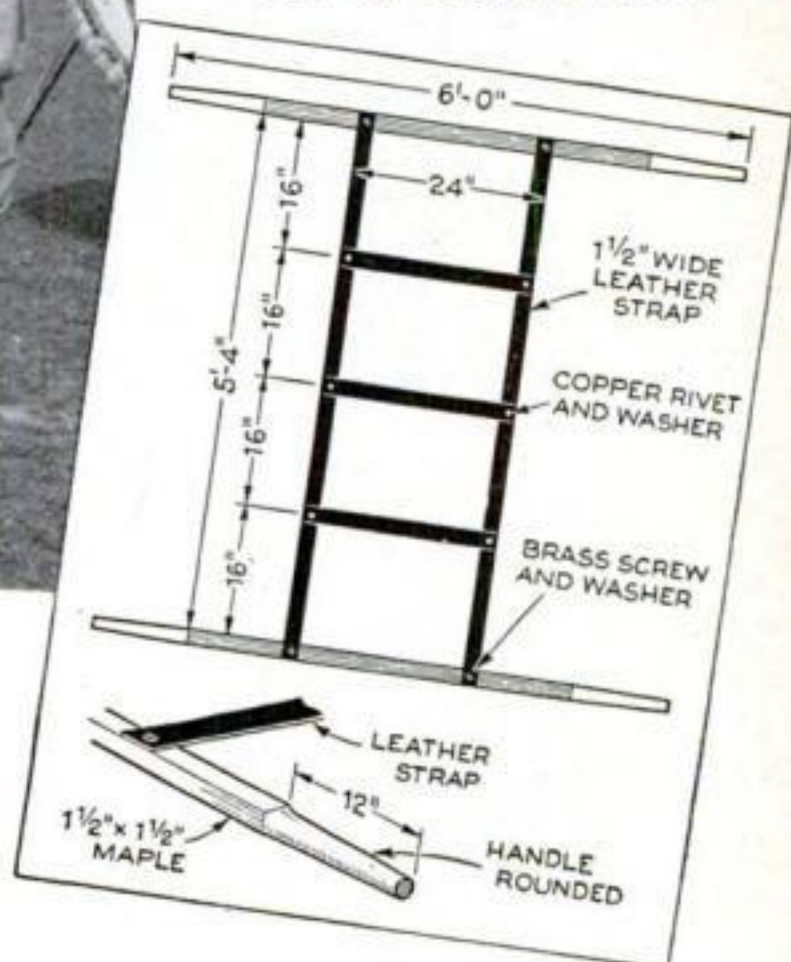
Sunglasses for Emergency Use

THOSE who regularly wear spectacles can convert them into efficient sunglasses when necessary by the method illustrated. This idea has long been employed by the Eskimos to prevent snow blindness. It is an invaluable expedient when one is exposed to brilliant sunlight and eye-searing reflections on a fishing trip, at the beach, or in the snow and has had no opportunity to provide regular sunglasses. The spectacles continue to give the necessary optical correction.—J. E. H.



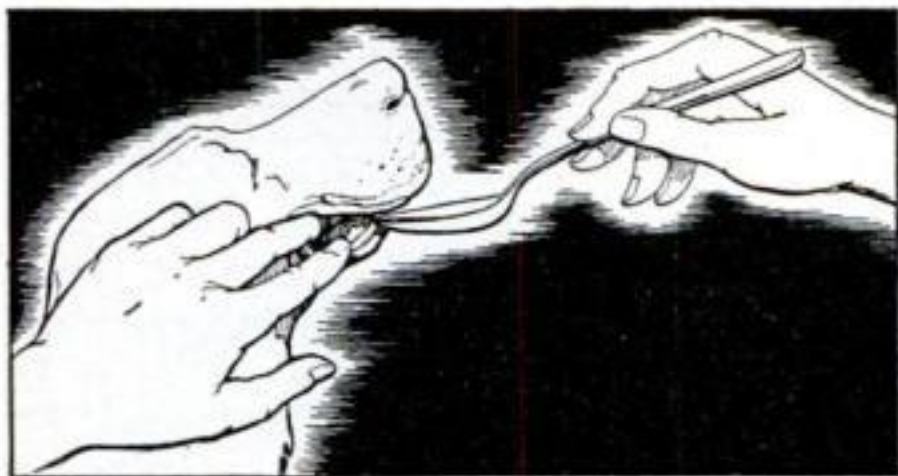
Two persons can carry a heavy target. The leather harness is attached to the wood as shown at right

Archery Targets Easily Carried on a Stretcher



STANDARD archery targets, which are quite heavy, can be carried easily in a "stretcher" made as shown. The handles are two pieces of $1\frac{1}{2}$ " square maple 6' long, the ends of which are shaped round for about 12" so they will not hurt the hands. Two pieces of leather of harness thickness, 67" long and $1\frac{1}{2}$ " wide, are fastened to the bars with 1" No. 8 roundhead brass screws and washers at points 12" on each side of the center. Three 24" long

pieces of leather of the same thickness are spaced equally apart along the 64" lengths and fastened with flathead copper rivets and washers. Sandpaper and stain the bars, if desired; then give the wood a coat of shellac or varnish.—LESLIE D. WILDING.



Giving Liquid Medicine Safely to a Dog

THE easiest and safest way to give a dog liquid medicine is to pour it either from a spoon or a vial into the corner of the mouth. The dog's head should be held at an angle of about 45 deg., and the first and second finger of the left hand used to part the loose flews at the corner of the mouth. Pour the medicine into the pocket so made. The head then can be gradually tipped back while the jaws are being held shut. This will cause the dog to swallow the medicine naturally.—W. H. FOSTER.

Knee Bands Repel Briers

HUNTERS, campers, and hikers know how annoying it is when briers catch on the part of the sock that overlaps the top of the boot or get into the boot itself. To prevent this, cut two bands of inner tube 3" or 4" long, clean them thoroughly, and slip one over each boot, pulling it up until half the rubber extends beyond the boot and covers the overlapping sock.—JAMES E. POLISSO.

The band of rubber forms a flexible and comfortable seal between the boot and the leg





Marine Luncheon Ensemble

IN RICH BLUE PLASTIC



RICH-LOOKING, gemlike blue plastic material is used for this novel marine ensemble. It is intended to decorate a table for two, but if additional place-card and salt holders are made, it will serve for as many guests as desired. Conventionalized starfish serve as the candleholders, sea horses hold place cards in their mouths, a baby turtle carries salt, a crab's back is filled with salted nuts, cigarettes sprout from a scallop-shell container, another scallop shell guards an ash tray and match holder, while a modernistic fish forms the centerpiece. The designs are from the Metropolitan Junior Achievement, New York.

All shapes are cut out with a jig saw, then carved with a hand motor tool, if available. Candleholders, place-card holders, and salt and nut holders are each made in a single piece. The centerpiece has a base representing wave ripples, fastened on with strong liquid glue or, better still, the special cement supplied by the plastic manufacturer. The combination ash tray and match holder is made in two pieces, cemented together as shown. The cigarette holder requires three pieces. Polishing is done as outlined in previous articles of this series.

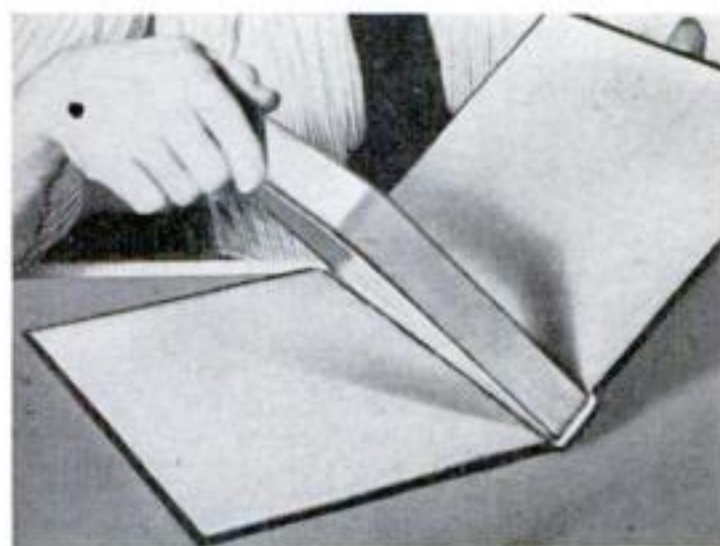
Cups to fit the nut and salt holders, and

to form ash trays, are made of pewter. Narrow strips of pewter are first bent to form rings, then the bottom pieces are cut out and soldered onto them with very soft, low-melting solder.

Leather Album Converted into Stationery Box



With a sharp knife, all the pages are cut away so only the back and covers remain



Make a suitable wooden frame and glue it to the back and bottom cover of the book



OLD-FASHIONED photograph albums or large leather-covered books can be converted into attractive boxes for stationery, candy, trinkets, and the like at practically no cost.

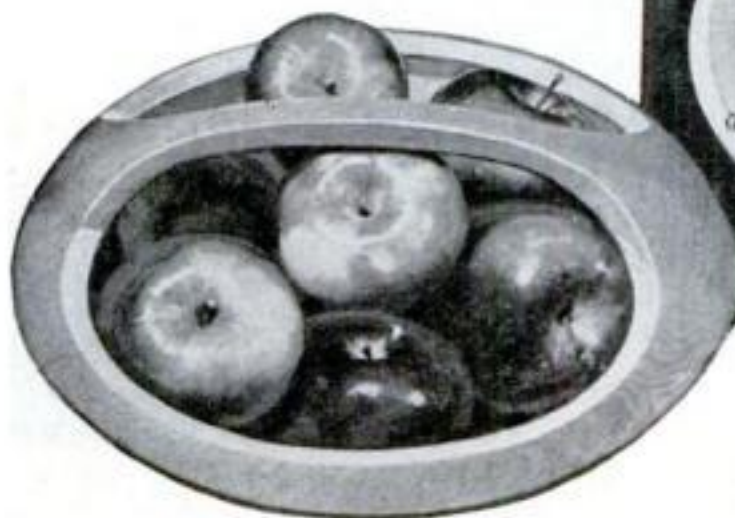
Measure the length, width, and thickness of the leaves only (not the covers). From these dimensions make the four sides of the frame or box from $3/16$ " soft pine or basswood strips. Have the strip along the back slightly wider than the other sides.

While the glue on the frame is setting, cut all leaves except the flyleaves (if any) away from the covers. Fit the frame into the cover, and glue the back and the lower edges in place. Glue a strip of cloth along the inside edge where the cover hinges on the wood frame. The outside edges of the box are painted with gilt and then given a coat of dull varnish.—J. W. C.

Altered Chopping Bowls Form Attractive Fruit Holder

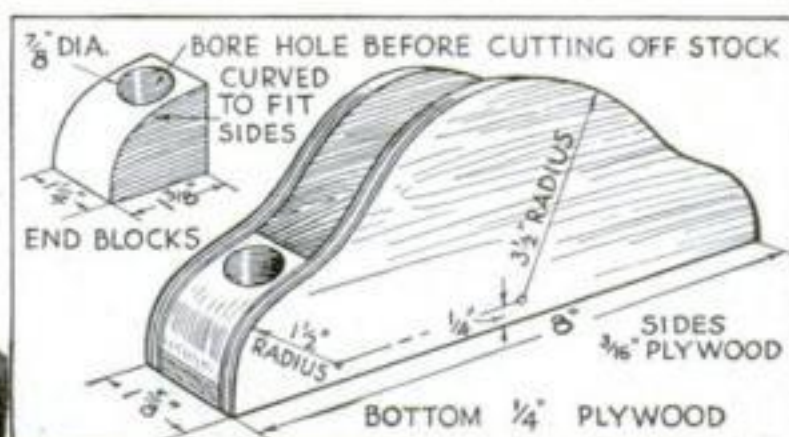
AN ATTRACTIVE fruit bowl may be made from two maple chopping bowls. With a jig saw, cut one bowl out as shown, leaving a handle $5/8$ " wide. As the bottoms of most chopping bowls are comparatively thin, it is a good idea to reinforce the handle by gluing a small strip of maple on the top side.

The edges of the bowls must be sanded smooth and flat to fit together perfectly. To make a strong joint, short $3/16$ " dowels are inserted and glued in holes drilled at intervals around the edges of both bowls. Rubber bands cut from inner tubes may be used to hold the bowls together while the glue sets. Then remove the bands and give the edges a thorough sanding. Two coats of flat-drying varnish give a soft finish.



The bowls are held together by means of glue and short $3/16$ " dowels inserted at intervals around the edge

Colorful Table Novelty Holds Paper Napkins



THIS gayly painted napkin set lends added color to a refreshment table or tray when snacks and titbits are served. It holds a supply of small, square-folded paper napkins and colored toothpicks for spear-*ing hors d'oeuvres*.

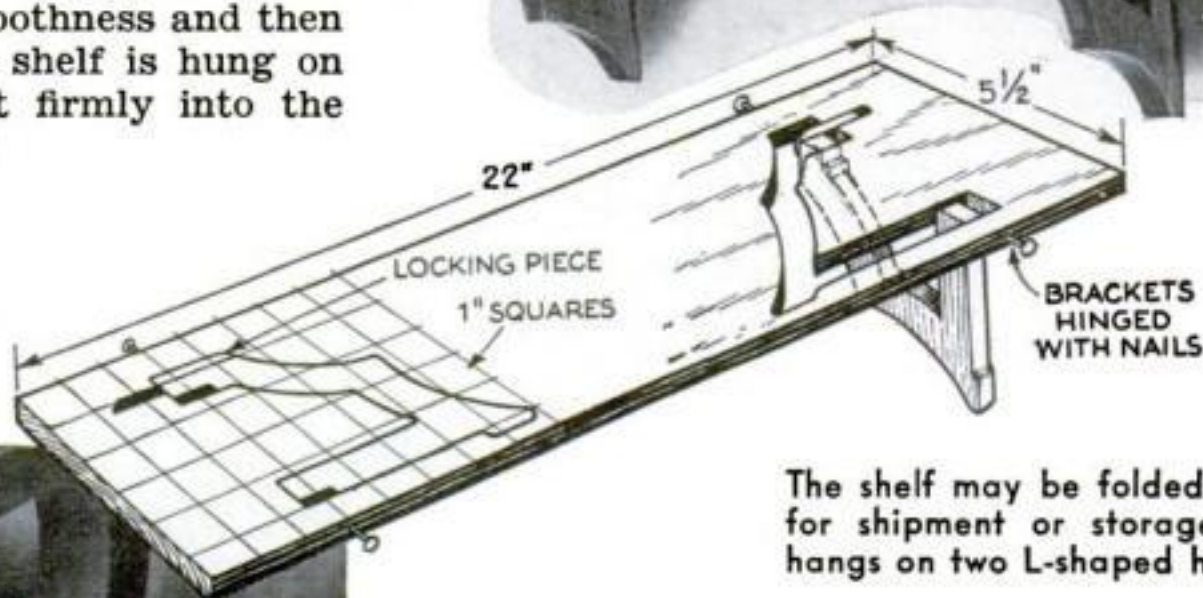
The two plywood sides, $\frac{3}{16}$ " thick, are tacked together and scroll-sawed at once. The bottom is $\frac{1}{4}$ " plywood, $1\frac{1}{4}$ " by 8". The end blocks are maple. To avoid splitting them, they were first bored with $\frac{7}{8}$ " holes as shown, then cut off. Assemble with brads, sand with No. 0 garnet paper, and paint any desired color. Transfers or hand-painted decorations can then be added in any style preferred. The holder shown is painted pea green. —BRUCE MACINTOSH.

Portable Shelf Contains Its Own Brackets

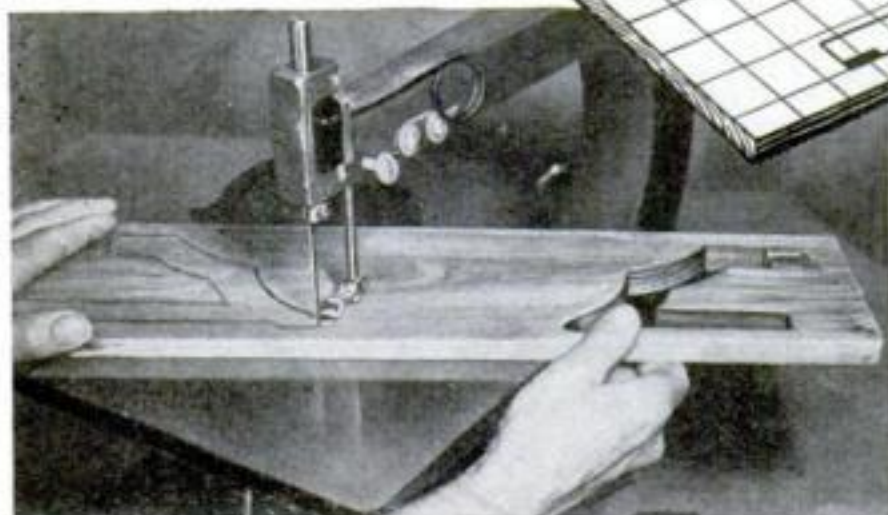
ONE piece of walnut $5\frac{1}{2}$ " by 22" furnished the material for this portable shelf, which folds flat for shipment or storage. After being jig-sawed as shown, the brackets are hinged with nails. The heads are cut off and the nails driven below the surface so that the holes may be concealed with slivers of walnut, which are glued into place and sanded smooth.

Note that the brackets are designed so that they can be locked in the open position by means of two small locking pieces. All surfaces are sanded to smoothness and then finished with shellac. The shelf is hung on L-shaped screw hooks set firmly into the wall. —FRANK WHELOCK.

Brackets and shelf are jig-sawed from one piece. Note the ingenious lock for holding the brackets in position



The shelf may be folded flat for shipment or storage. It hangs on two L-shaped hooks



Tiny Parts Cut from Paper

VERY small ship model fittings, such as boom and gaff jaws, and other tiny craft-work parts usually made of wood can be cut from six or seven layers of bond paper glued together with cellulose cement.

Ivy-Pot Bracket of Hammered Copper

ALTHOUGH there are many ways to hang a pot of ivy against the wall, one of the simplest and most ornamental is to make a bracket like the one illustrated. You may, indeed, wish to construct several of them because they are so simple. They can be hung on windows or walls, as preferred. Adapt the dimensions to suit the pot used. In this case it happened to be 3" in diameter at the bottom, 4½" at the top, and 4" high.

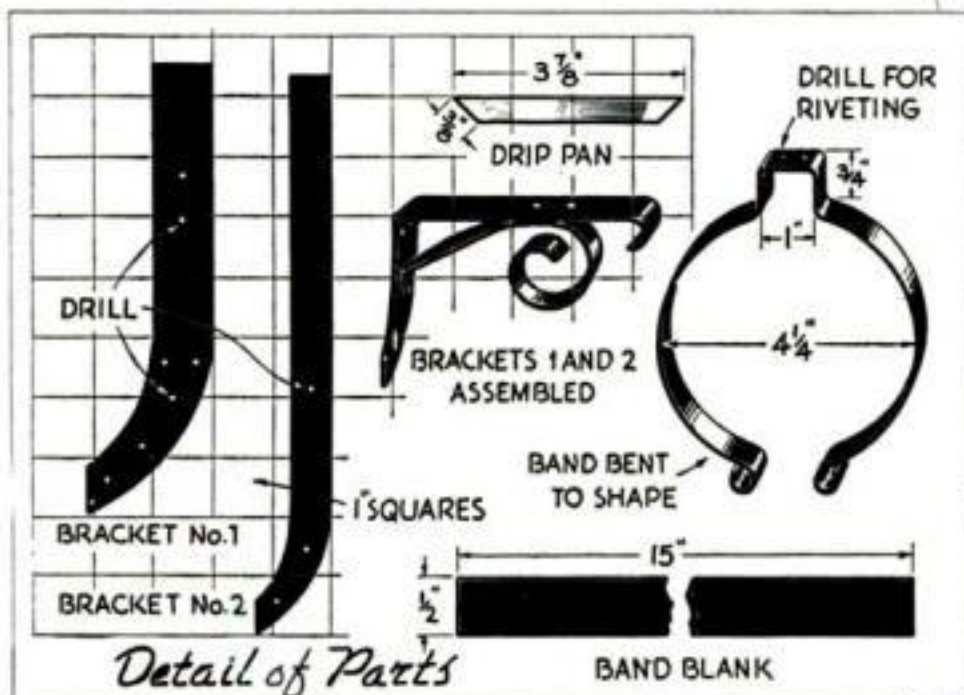
The back plate is outlined on a piece of 14-gauge soft sheet copper, and is cut with the tin shears and a cold chisel, filed smooth, and hammered on the face. The bracket parts and the band are cut from 16-gauge stock, and are hammered and formed as shown in the drawings. The drip pan is a disk of 18-gauge soft sheet copper. It is raised to a depth of about ⅜"; then the bottom corner is formed.

Assemble all parts with No. 14 brass rivets or escutcheon pins. Swab the surface with a liquid solution of copper nitrate and heat until black. Dust off and repeat until completely black, then wax with floor wax and polish.

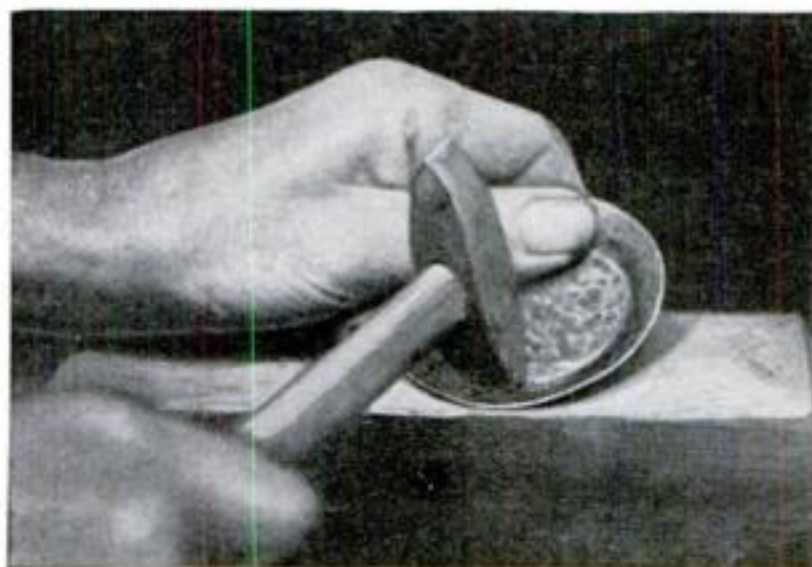
Iron may be used in place of copper and painted dead black.—DICK HUTCHINSON.



The scroll is cut with tin shears and cold chisel from a piece of 14-gauge copper



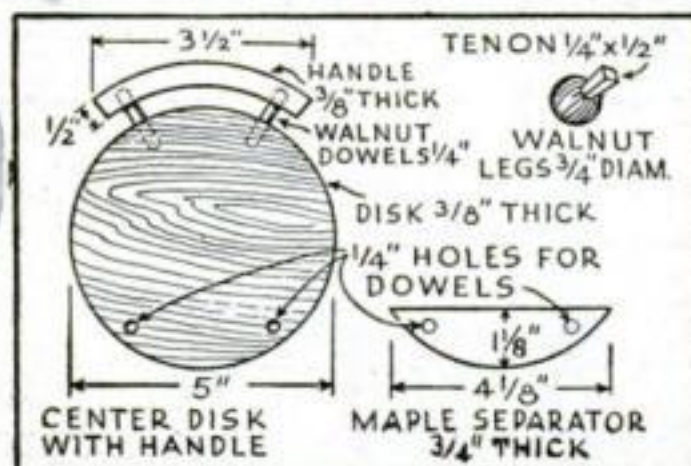
The parts are riveted together as at right. Below, forming bottom corner of the drip pan





Modern Toast Rack Made from Disks of Walnut

THIS decorative toast rack consists of seven disks of $\frac{3}{8}$ " walnut cut 5" in diameter, and six maple separators cut from $\frac{3}{4}$ " stock to the shape shown. The pieces are assembled with $\frac{1}{4}$ " birch or maple dowels. A walnut handle is scroll-sawed as indicated and attached to the center walnut disk by means of two $\frac{1}{4}$ " dowels, but in this case they should be walnut. The feet are turned from $\frac{3}{4}$ " walnut, and the tenons on them are glued into holes drilled in the first separator at either end. Two coats of thin shellac are applied, and the surface is rubbed down with steel wool between coats.



BROWN AND GREEN COLORS

[METAL WORKING]

The following formula will produce a permanent finish, either brown or black, on copper, brass, bronze, or nickel silver:

Place some commercial nitric acid in a glass jar, and dissolve all of the scrap copper that the acid will consume, thereby producing a liquid copper nitrate. Do not allow this solution to come in contact with the hands or clothing. Using a swab, coat the surface of the piece to be colored with the acid. Apply heat, preferably with a blowtorch, until it turns first green, then brown. Stop the heat the moment the piece is all brown or the color will burn out. Let cool and dust off. If the color is not dark enough, repeat the operation.

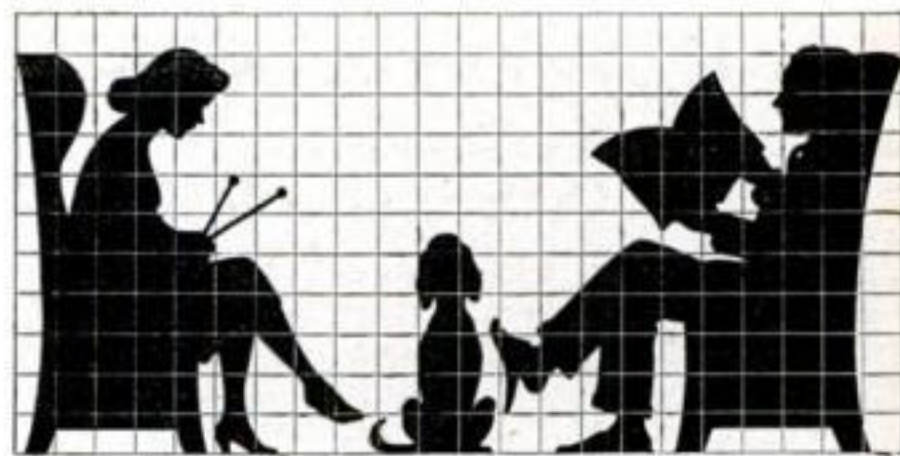
About three burnings will be required to produce a good black finish. If the brown finish is used, burnish the high lights on the hammered parts with fine emery paper. Polish the finished work with ordinary floor wax. No lacquer is necessary.

A satisfactory verd-antique or verdigris-green finish may be produced by coating the piece with copper nitrate as above and allowing it to dry in the sun or in a warm room. When thoroughly dry, coat with lacquer. This is excellent for out-of-doors work such as lanterns, hardware, and copper trim.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

New Marble Game Tests Steadiness of Hand

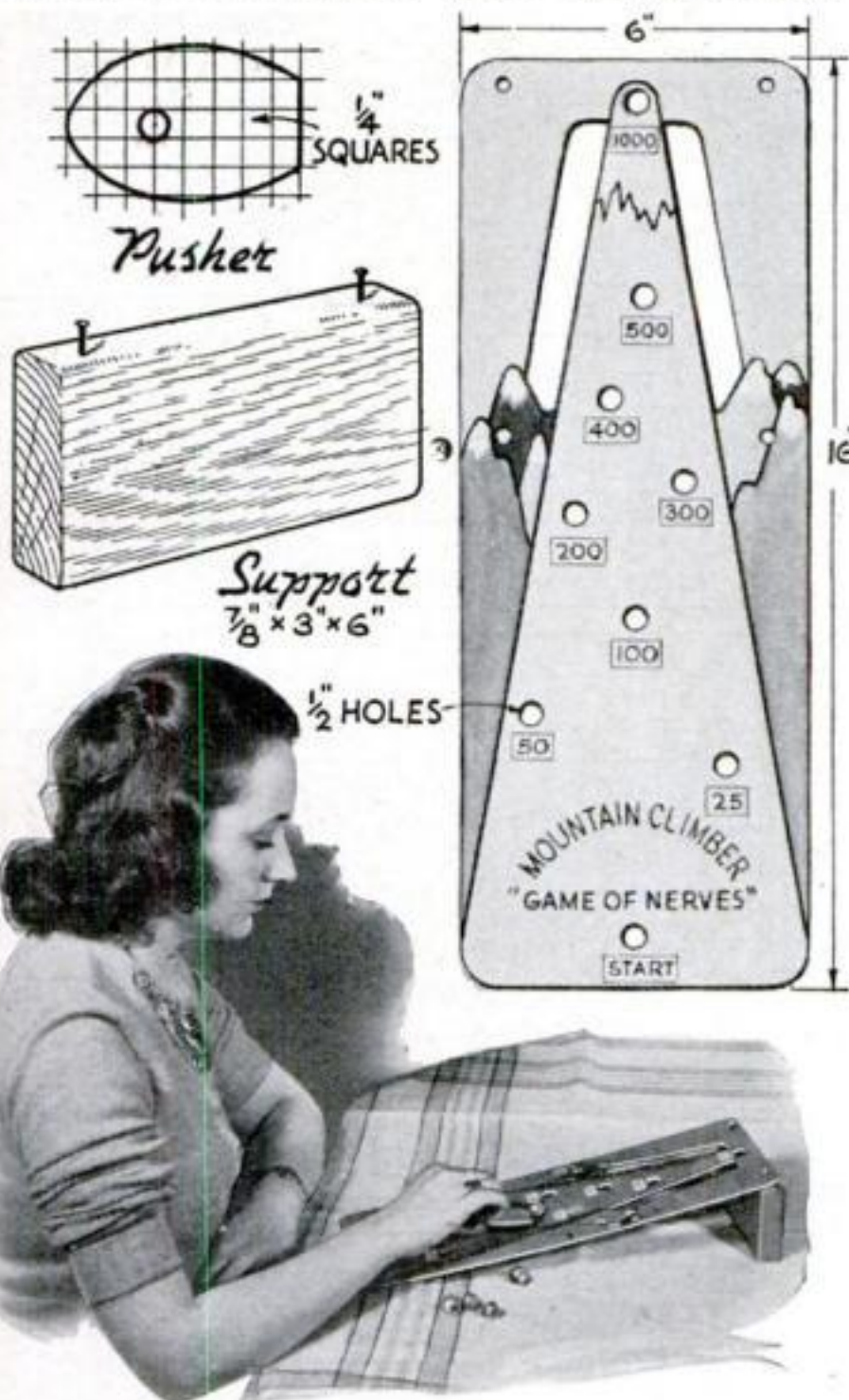
"MOUNTAIN CLIMBER" is a fascinating new table game in which marbles are pushed up an incline with the aid of a small, flat stick until they fall into numbered holes. Although the game may look easy, the marbles have a tendency to roll off the side of the stick. A good score therefore calls



Silhouette of the Month: "Fireside Comfort"

HERE is a silhouette that can be adapted to many purposes. Scroll-sawed from plywood, the figures can be used, for example, as a name board or to ornament an illuminated house number. Cut from sheet metal, they will decorate a fireplace screen. Since they are separate, the figures can be set as far apart as the individual project requires, or they can be used individually. Any degree of enlargement may be obtained by drawing squares of the necessary size and copying the outlines through the squares from point to point.

Suggestions for using the design to decorate craftwork



The object of the game is to push marbles up the "mountain" so that each stops in a numbered hole

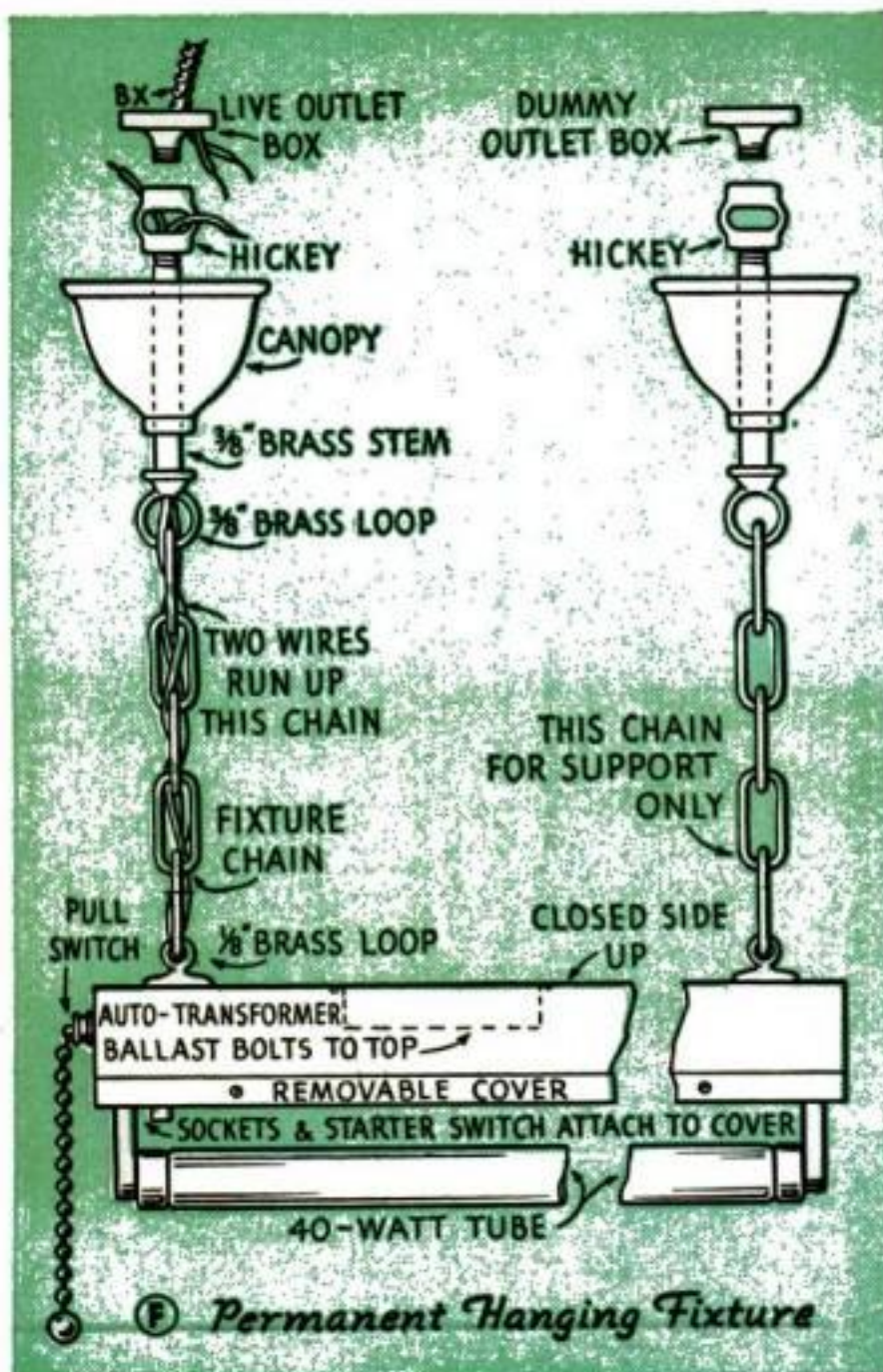
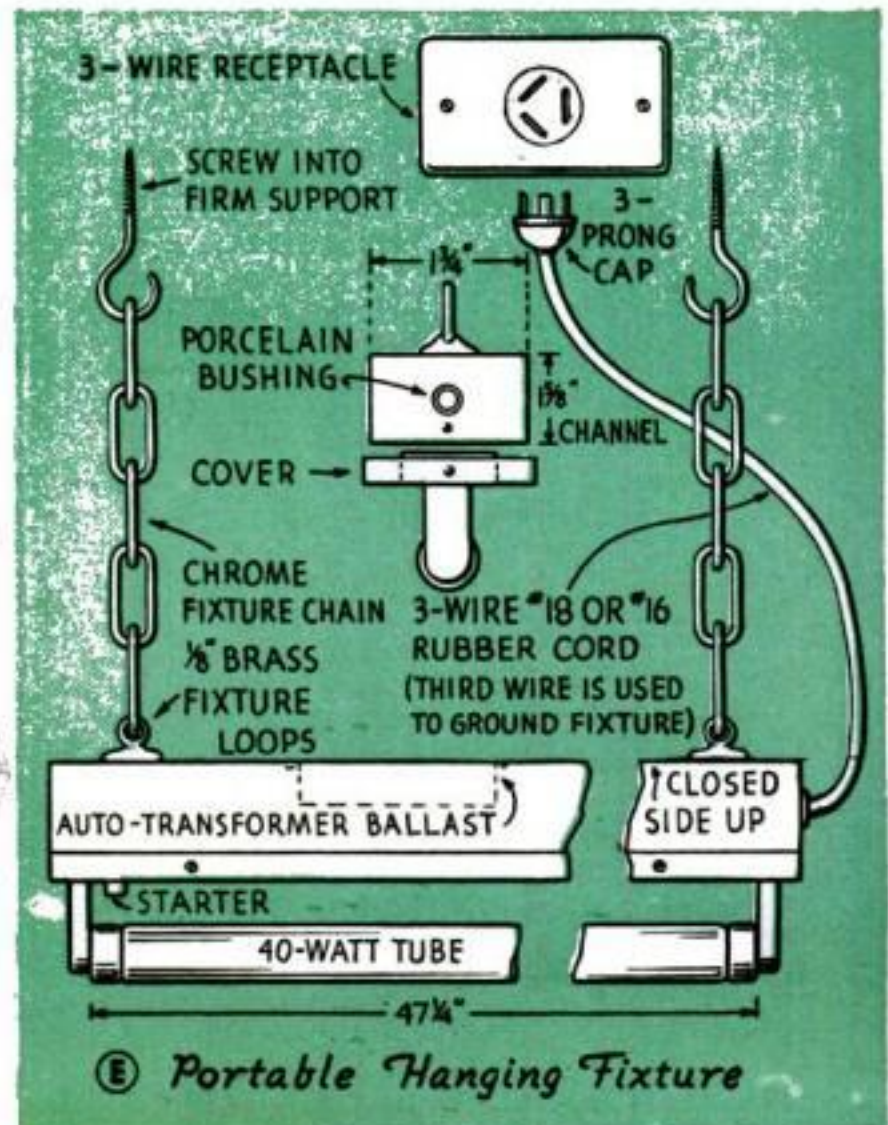
for steadiness of hand and calm nerves. Considerable practice is required before one can control the marbles.

Each player is given five marbles for the "climb." When all have been used, the ones which have been successfully deposited in holes are counted according to the value of the holes. The highest score wins.

Once a marble drops into a hole it cannot "climb" again. When a marble falls down the mountain it is "lost."

Whether made of heavy cardboard or wood, the incline should have a smooth, flat surface. Paint or wax crayons may be used for the decorations.—MYRON FLEISHMAN.

BUILDING YOUR OWN *Fluorescent*



A THIRD problem in building fluorescent lighting fixtures is where a portable fixture is desired, and the ceiling height is such that the lamp must be suspended on chains. The fixture is made as before (drawing D), but it is suspended by means of two brass loops and chains, as at E. A rubber cord and plug allow connections to be made to a three-wire polarized receptacle.

Reflectors can be easily added to any of these fixtures by bending up the material to the required shape, as shown in drawing G. Polished aluminum or sheet metal sprayed with white enamel or lacquer gives a satisfactory surface.

In general, 15-watt, 20-watt, and 40-watt tubes are 1 1/2" in diameter and have a comparatively low surface brightness. Because of this, they can be used exposed without reflectors and will give a good spread of light all over a room. On the other hand, the 1" diameter 15- and 30-watt tubes are somewhat brighter and should be used in a reflector when possible to protect the eyes.

One of the main features of the fixtures illustrated is the use of the new separate starter switch. Formerly the switch and reactor were combined in one unit called an auxiliary. If the switch went bad, the whole

Lighting Fixtures

PART TWO

By
**HAROLD P.
STRAND**

unit had to be replaced. The latest advance in the industry is a small starter switch, which is easily inserted and removed from the bottom of the fixture. With this is used a simple ballast or reactor.

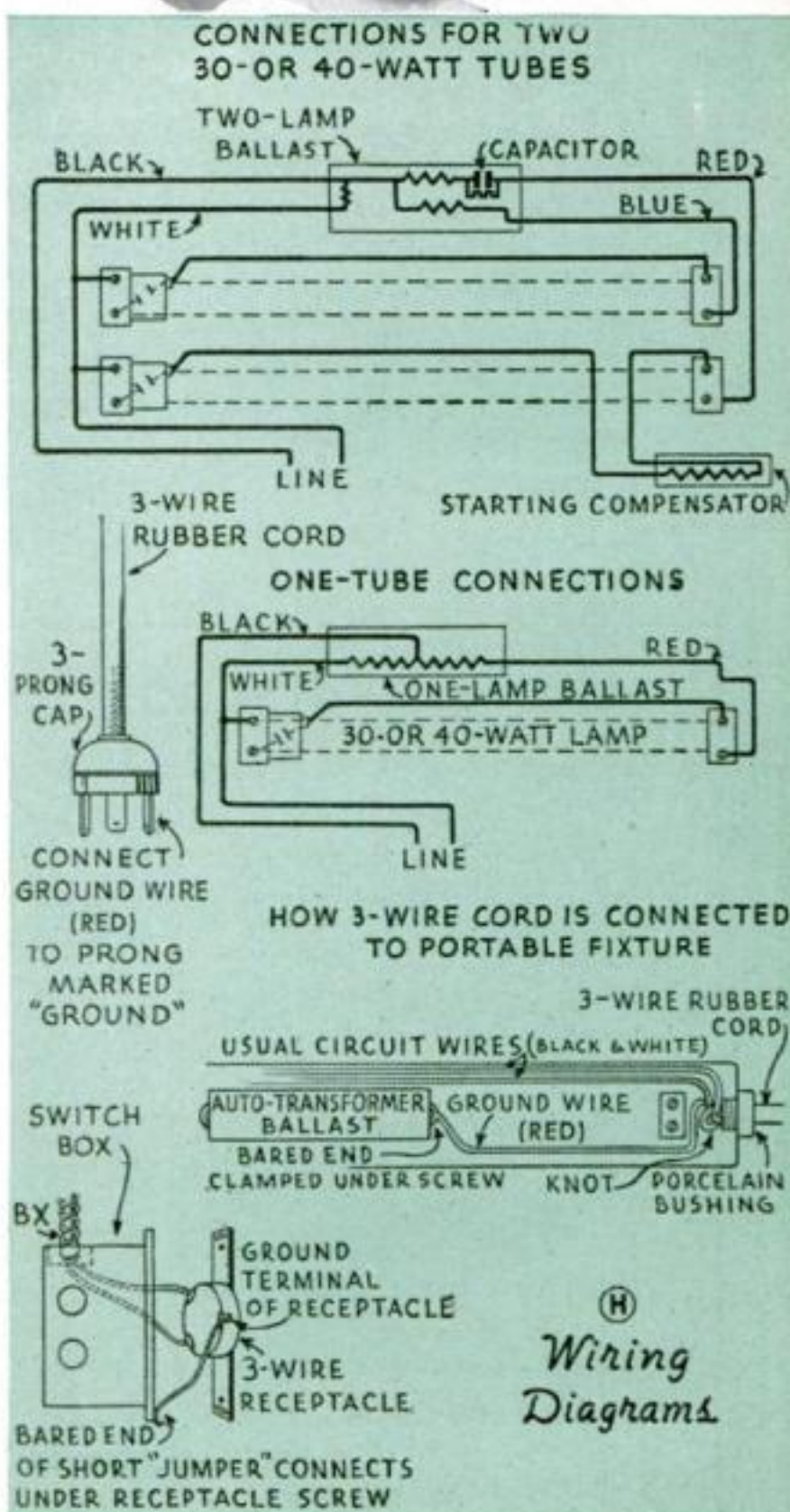
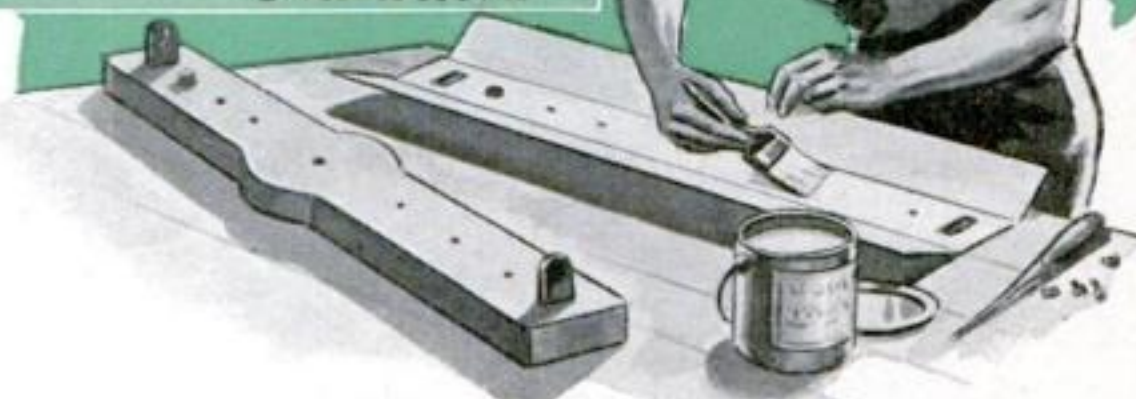
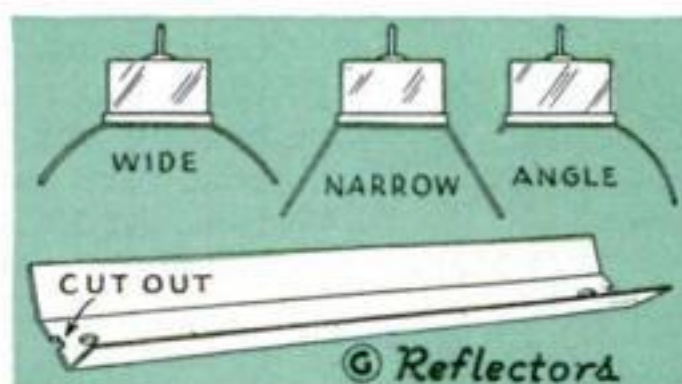
If, however, 30- or 40-watt tubes are to be operated, an auto-transformer must be used with the starter switch, and it also serves as the ballast. This is because the longer tubes do not operate directly at the low 115-volt pressure, but must have equipment to step it up to the required voltage.

An excellent method of hanging fixtures permanently on chains is shown at *F*.

When making fixtures using two tubes, a two-lamp ballast unit can be substituted for two ballasts. This contains a capacitor to correct low power factor and flicker, and makes an efficient control unit. However, care must be taken to see that the channel dimensions are sufficient to accommodate the larger unit. When using this type of unit and separate starter switches with the 30- and 40-watt tubes, however, a separate compensator may have to be used in addition. This is placed in the channel with the ballast (drawing *H*.)

With single-tube fixtures, the low power factor that is characteristic of fluorescent lamps can be corrected by installing small capacitors in the channel. If preferred, however, a larger one can be installed elsewhere to take care of several lamps. For an individual lamp, a capacitor of 4.75 microfarads will bring up a power factor of about 50 percent to nearly 90 percent. A capacitor of 17.5 microfarads can be used for five 30- or 40-watt tubes with a thermal type auxiliary or starter to obtain 90 percent power factor. These devices are connected across the line at or near the ballast.

Fluorescent lamps can also be operated





Fluorescent fixtures are ideal for the laundry room

on direct current with some success. In general, only the 15- and 20-watt sizes can be used because it is not possible to step up 115-volt current to the higher voltage for starting the larger lamps.

The only change necessary for D.C. operation is to connect a resistor in series with the reactor or ballast to limit the current. Care must be used to ventilate the resistor properly because of heating, and connections should be made with wire having heat-resisting insulation. At 120 volts the 15-watt T-8 tube requires a resistor of 198 ohms and the 20-watt T-12 tube a resistor of 144 ohms. For 115 volts, resistors of 180 ohms and 125 ohms respectively would be required. The efficiency is less than with A.C. operation.

The construction described is standard practice, but some localities may have adopted special regulations so ask your electrical inspector if in doubt.

Foil-Lined Lamp Shade Acts as a Reflector

BY LINING them with metal foil, metal lamp shades like the conical one shown can be made into efficient reflectors that concentrate the light mainly in one direction. The foil can be fastened by coating the shade surface with spar varnish, enamel, or baking enamel, letting it dry until tacky, and then pressing the lining into contact. It can be smoothed out to make a good specular (mirrorlike) reflector, or crinkled to scatter the reflected light over a wider angle.



FLEXIBLE CORDS TO USE

[ELECTRICAL]

When an electrical appliance requires the replacement of its cord, select the proper type of cord to insure safe operation, as follows:

Use	Trade name	Type	Outer covering
Flat irons, toasters, waffle irons, grills, room heaters, mangles, used in dry places	Heater cord	HPD	Cotton or rayon
Heating use, damp places	Rubber-jacketed heater cord	HSJ	Cotton and rubber
Lamps, small radios, light appliances, dry places	Parallel cord	PO-64	Cotton or rayon
	" "	PO-32	" " "
	" "	PO	" " "
Lamps, etc., damp or dry places	All rubber	POSJ-64	Rubber
	Parallel cord	POSJ-32	"
Vacuum cleaners, large radios, drills, refrigerators, washing machines, shop motors, etc., damp or dry places	Junior rubber cord	SJ	Rubber
Extra hard usage or heavy duty	Hard service rubber cord	S	Rubber
Subject to mechanical injury, dry places	Armored reënforced cord	PA	Cotton and metal armor

POPULAR SCIENCE MONTHLY SHOP DATA FILE

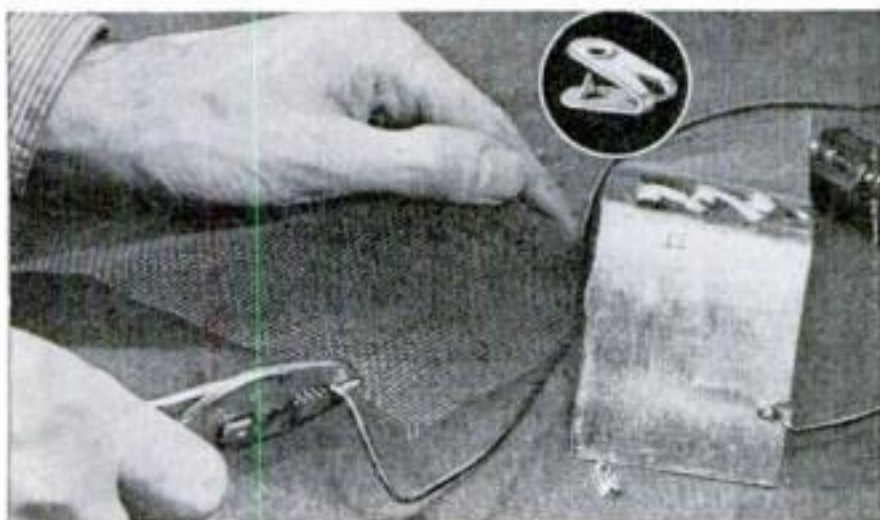


BX-Conduit Saves Time in Coiling Fish Tape

ONE electrician coils his fish tape through an 18" piece of BX so it can be handled rapidly without kinking. By holding the flexible BX in one hand and revolving the rolled steel fish tape with the other hand, he feeds the tape into the conduit swiftly.

Attaching Wires Quickly

IN EXPERIMENTAL work, wires can be connected temporarily to sheet metal or screen wire with brass paper fasteners of the type shown. Insert the wire into the fold of the fastener and squeeze shut over the edge of the material. For sheet metal, punch a small hole. Solder for greater permanency.

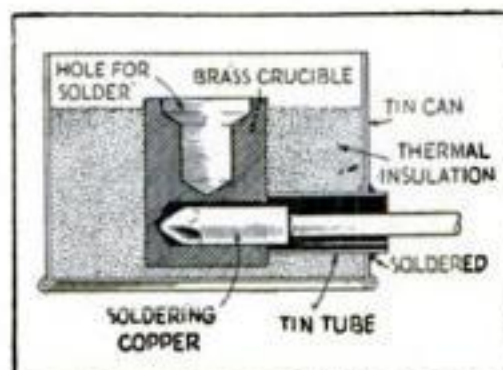


Soldering Copper Heats Miniature Furnace

RADIO repairmen, electricians, and others having occasion to tin wires or similar small parts will find the miniature electric furnace illustrated below a great convenience.

The brass crucible is a short piece of brass rod of a diameter slightly greater than the length of the small soldering-copper head. A hole is drilled to receive the copper, and another to form a cavity for the molten solder. The crucible is placed in a housing made by cutting down a tin can, and surrounded with thermal insulation such as glass wool, asbestos, or plaster. A tube, made from a piece of the tin can, connects the lateral hole in the crucible with the outside of the housing. If the insulating material does not hold the parts securely, fasten the crucible with a machine screw through the bottom of the housing.

The soldering copper may require ten or fifteen minutes to heat the crucible to the melting point of solder. The process can be hastened, if necessary, by directing a torch flame into the furnace from the top. A lid made of asbestos or other suitable material will reduce the escape of heat from the top. To tin wire ends, coat them with flux and dip them into the molten solder. The soldering copper can be removed for several minutes at a time without permitting the solder to solidify. It is best to place a thin layer of insulation under the furnace so the bench top will not be scorched if the metal becomes too hot.—ERVIN WALTERS.



In the furnace shown above, the thermal insulator was sand, which was covered with wood-fiber plaster after the device had been tested.

Stopping Action

By R. O. LISSAMAN

WHEN you photograph a moving person, animal, or object, the image moves across the surface of the film—that is, the focal plane of the camera—for the duration of the exposure. For the action to appear completely stopped, the exposure must be brief enough to permit a movement of not more than about 0.01" when the finished print is viewed at normal viewing distance. Although an image displacement of 0.01" will be satisfactory for a contact print, a negative that is to be enlarged must show less movement than that. For example, if it be desired to enlarge the negative five times, the film should have an image displacement of not more than 0.002". An accompanying table gives the approximate exposure for stopping action of various types. The shutter speeds are

Foot race at angle to camera. First man is Taisto Maki, coached by Paavo Nurmi



Action directly across the camera, as in this case, requires faster exposure than movement at an angle

with Your Camera

the slowest that can safely be used. In each case for action of 20 m.p.h. or faster, three speeds are indicated. The fastest is for use when the movement is across the field of vision from right to left or vice versa. The second is for movement at an angle, and the third or slowest is for movement approaching the camera. The table is based on the average focal length of lenses in popular use, that is, a 2" lens for miniature cameras and a 4" lens for a camera using the so-called "twenty" size film.

For contact prints, a short focal-length lens, such as those used in miniature cameras, will show less image displacement with the same action and same exposure than a lens of longer focal length. If enlargements are to be made, remember that the greater the enlargement desired, the shorter the exposure must be. Close-up action requires shorter exposure than does distant action.

Although the table gives all the information an amateur is likely to require in learning to make good action shots, there are some photographers who are keenly interested in theo-

ry. For their benefit the following formula is given for working out the exposure necessary to stop action in any individual case. *All measurements must be given in inches.*



1. Distance object will move compared



Approaching action at a speed of about 35 m.p.h. An exposure of 1/200th second stopped it

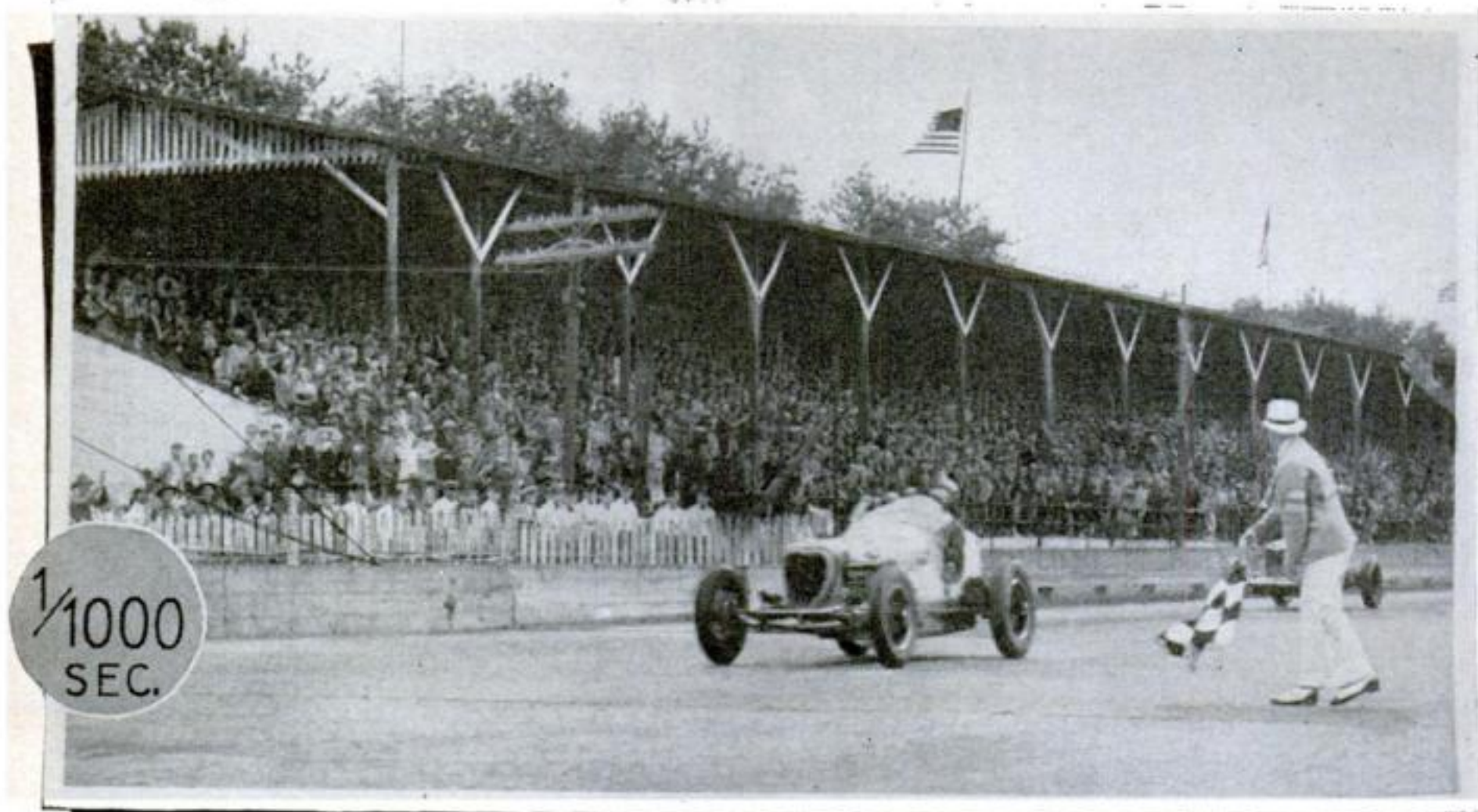
EXPOSURES TO STOP ACTION

[PHOTOGRAPHY]

Exposure for average miniature camera			Action	Miles per hour	Exposure for average 2¼" by 3¼" camera		
1/15 to 1/50					Average views, pedestrians, etc.	5	1/25 to 1/100
			<div>Athletic events, foot races, boats, baseball, slow street traffic, etc.</div> <div>Brisk traffic, horse races, motor boats, diving, etc.</div> <div>Highway traffic, birds on wing, planes fast trains, etc.</div>	<div></div> <div>20</div> <div>30</div> <div>60</div>			
1/100	1/65	1/40			1/200	1/130	1/80
1/200	1/130	1/60			1/400	1/260	1/120
1/350	1/250	1/125			1/700	1/500	1/250

Note: Use the shutter speed closest to the given speeds. For general use, speeds slower than 1/50 should not be hand held, especially if enlargements are required. The above figures will permit only contact prints or small enlargements to be made. The greater the enlargement desired, the shorter the exposure must be.

POPULAR SCIENCE MONTHLY SHOP DATA FILE



Snapping the finish of an auto race takes real speed, especially if you intend to enlarge the negative

with permissible image movement, which can be stated: Displacement permissible

$$\times \frac{\text{Distance to object}}{\text{Lens focal length}} \text{ or } \text{Disp.} \times \frac{D}{F}$$

2. Distance object will move in 1 second: At 1 mile per hour, 5,280' or 63,360"

object will move $\frac{63,360}{60}$ or 1,056" in 1 minute

and $\frac{1,056}{60}$ or 17.6" in 1 second

Thus the formula may be stated:
Required exposure in seconds=

$$\text{Disp.} \times \frac{D}{F} \div (17.6 \times \text{m.p.h.})$$

Example: To photograph a train at 60 m.p.h. at 50' (600") distant with lens of 3" focal length.

$$\frac{1}{100} \times \frac{600}{3} \div \frac{17.6 \times 60}{1} = \frac{1}{100} \times \frac{600}{3} \times \frac{1}{17.6 \times 60} = \frac{1}{528} \text{ second}$$

This gives the exposure when the movement is passing directly across the camera field of view. Action approaching or leaving the camera at 45 deg. may be stopped with one-third longer exposure. Action directly approaching or leaving may be stopped with two-thirds longer exposure.

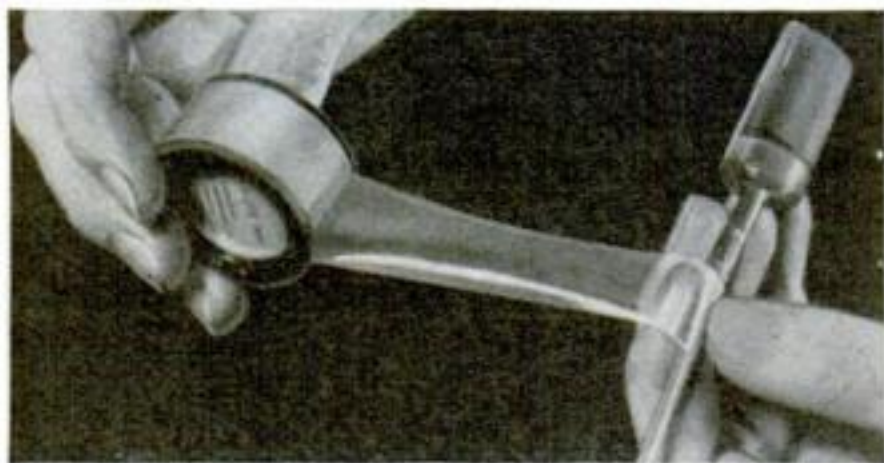
Roll-Film Tank Corked to Keep Out Dust

AFTER using a roll-film developing tank, it is advisable to plug the opening in the lid with a small cork or a pledget of cotton to keep out dust and chemicals that may be floating in the air.—E. A. B.



• • •

WHEN I have to make several prints of a photograph, I borrow the metronome from its place beside the piano. By counting its ticks, I can time the exposures and also the developing period.—FERDINAND G. HUP.



Scoop for Small Bottles

A SCOOP for getting into small-necked bottles when weighing photo chemicals may be made from a face-powder scoop of the type shown above. These scoops are designed for filling compacts and usually sell for five cents. All that is necessary is to extend the handle with a section of discarded knitting needle or a small dowel.



Wet Prints Trimmed Easily with Knife

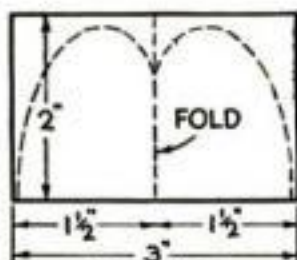
IF NO trimming board is available, by far the easiest way to trim photo prints, surprising as it may seem, is immediately after they have been washed and while they are still wet.

Place a wet print face up on a smooth board, such as a bread board, a piece of plywood, or a drawing board, and cut it with a very sharp, large pocketknife blade, a hunting knife, or any other stiff-bladed knife. A large drawing triangle makes the best guide because it gives greater safety to the fingers and can be held down better than a ruler.—O. P. SHIER.

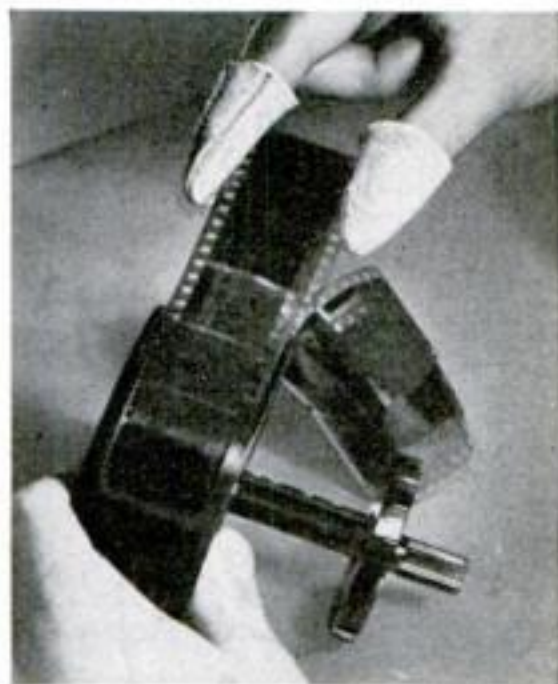
Avoiding Finger Marks When Loading Film

FINGER marks on film can cause irreparable damage, especially in warm weather or in a hot, poorly ventilated darkroom, when one's fingers are likely to be quite moist. Such blemishes are easily avoided, however, by using a pair of soft chamois finger cots for the thumb and forefinger. These will absorb moisture and protect the film while a tank or film cartridge is being loaded.

Cut a rectangle of paper 2" by 3" for the forefinger and another 1½" by 4" for the thumb. Wrap them around the fingers, mark the approximate size and shape, and use them as patterns for cutting the chamois. Stitch the cots as shown, fitting them so tight they won't slip off. Make a new pair when they begin to get dirty or collect too much lint.—NATHAN SPERBER.



PATTERN FOR INDEX FINGER



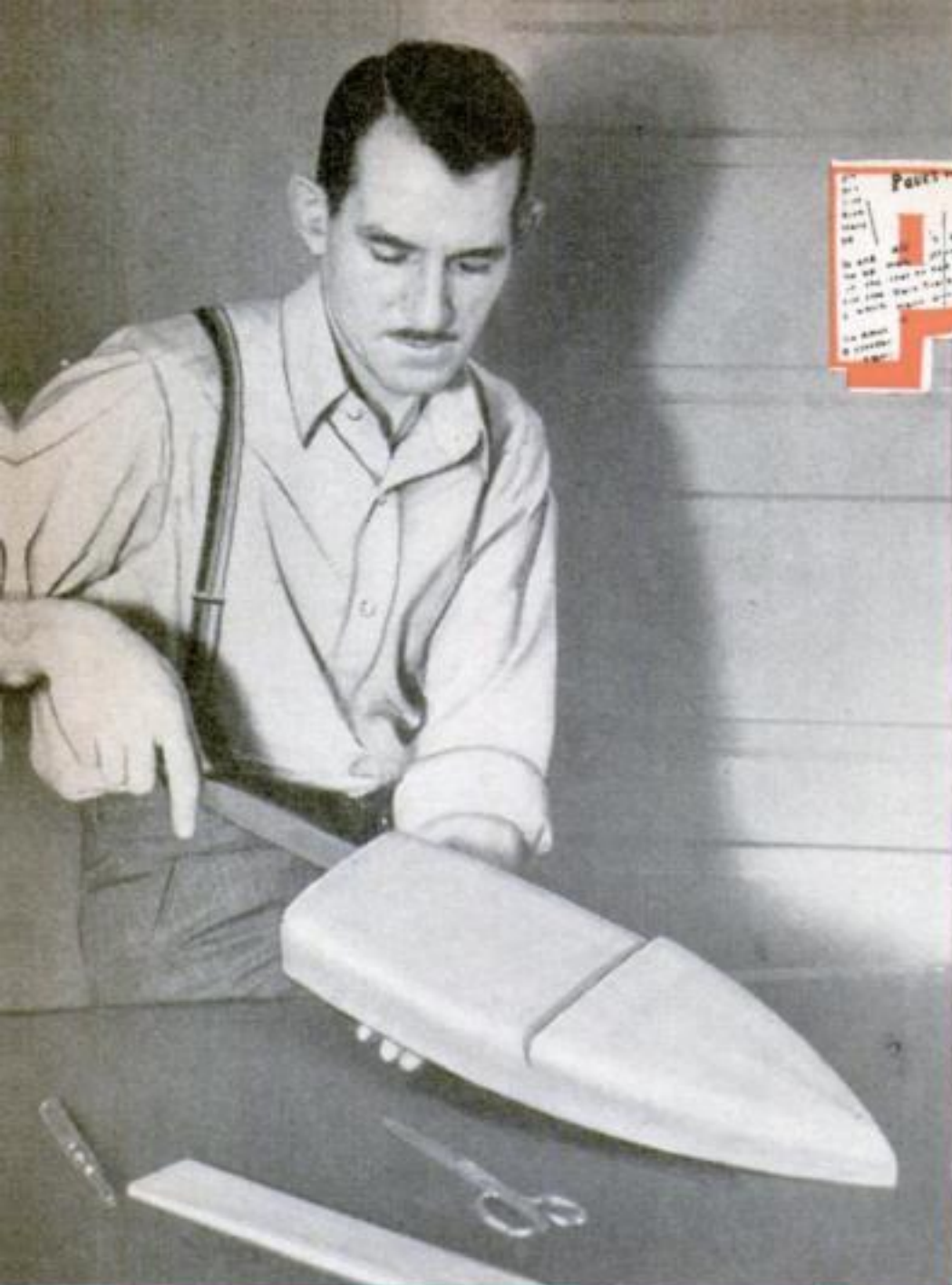
RETOUCHING PRINTS, PART I

[PHOTOGRAPHY]

With Artist's Black Oil Color. First apply a sizing medium to entire surface of print with a wad of cotton. (A good sizing medium consists of 1 oz. turpentine, ⅛ oz. linseed oil, and from 15 to 20 drops of japan gold size. Shake together well and let stand overnight.) For shading large areas, charge a cotton wad with black oil paint, and rub it on waste paper until the color can be applied lightly and evenly. For smaller areas, use bits of cotton twisted on the end of a toothpick or a paper stump. For lines and spots, use a spotting brush and thin the color with turpentine. Remove undesired or surplus color with the sizing medium. A scrap of glass will serve as a palette.

With Printer's Ink. Obtain half-tone black from a local printer or printing supply house. No sizing medium is required. Use like oil color, but thin with artist's pale drying oil. A soft eraser will remove undesired ink while still wet. This is a versatile medium and leaves such a tough film that glossy prints retouched with it may be referrotyped.

POPULAR SCIENCE MONTHLY SHOP DATA FILE



PAPER



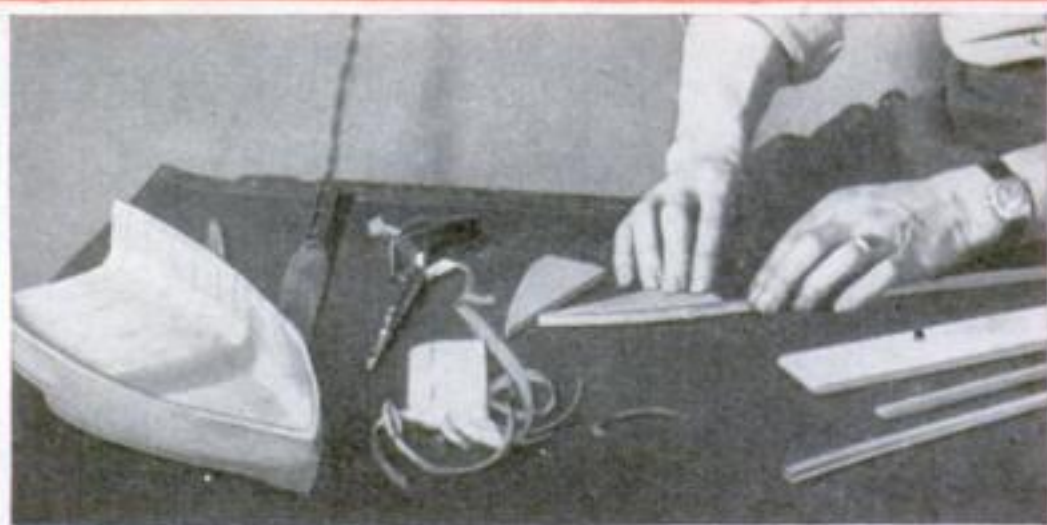
When the paper hull has dried, it is sanded and painted, then slipped off the form. The 18" hull shown weighs slightly over four ounces.

By
J. W. CLEMENT

EXCEPTIONALLY light, strong hulls for model speed boats can be made up of layers of gummed paper laid over a form cut from a solid piece of balsa or white pine. The form, Fig. 1, should be accurately shaped, but need not have a perfect surface.

If your model is to have a deck, it should be fitted to the form and held in place with two small brads or weak glue so that it can be removed after the hull is dry. When a steam power plant is to be installed, a deck will only be in the way, and it will be more practical to reinforce the hull, after the form is removed, with strips of white pine or mahogany as shown in Fig. 2. The transom may also be made of wood, fitted to the form and glued in place the same as the deck.

The first step in making paper hulls is to shape a form accurately out of balsa or white pine. Below, fitting the cowl and gunwale



As you may wish to use the form again, it is a good plan to give it a coat of linseed oil or hot paraffin. It is then covered with strips of wet newspaper laid approximately three layers deep. No glue is used.

The gummed paper, which goes on next, should not be over 1" wide. Cut off pieces a little longer than the form and, after dip-

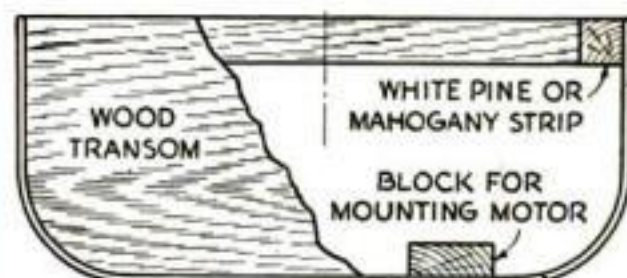
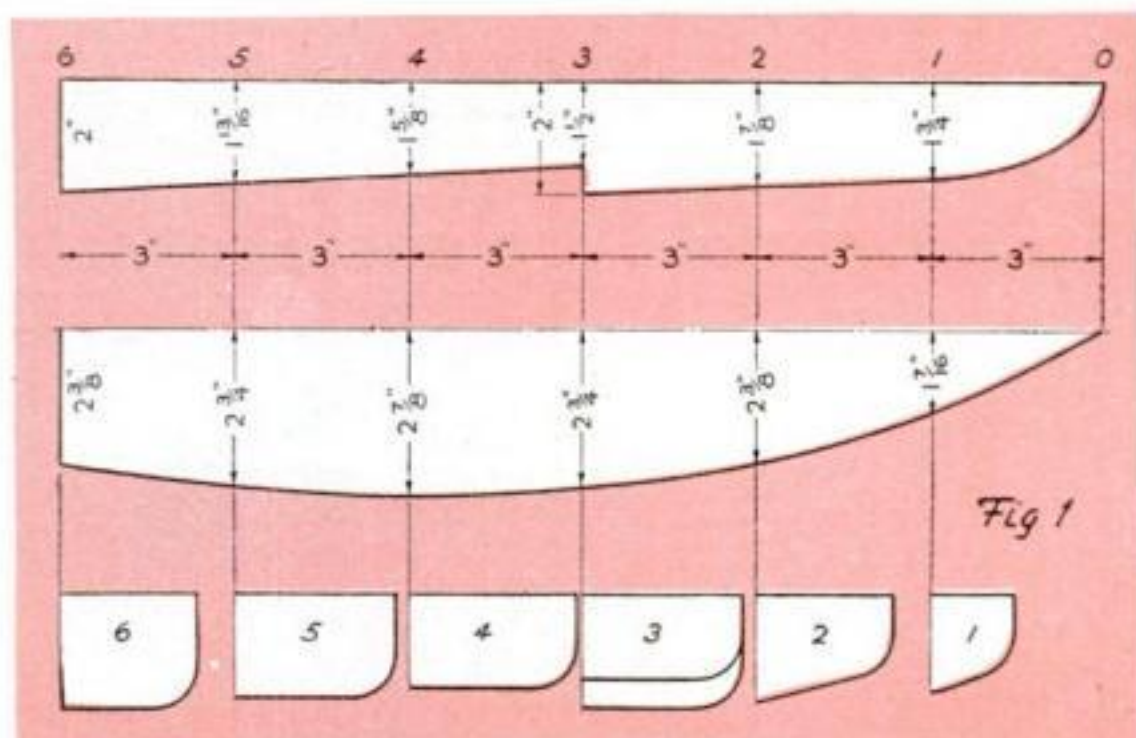
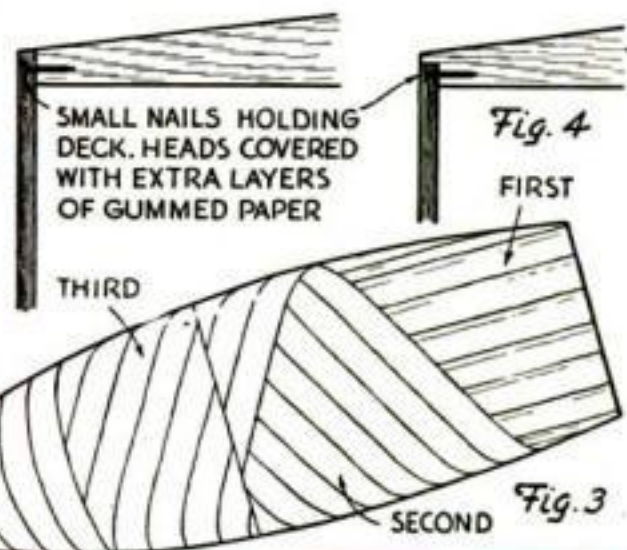
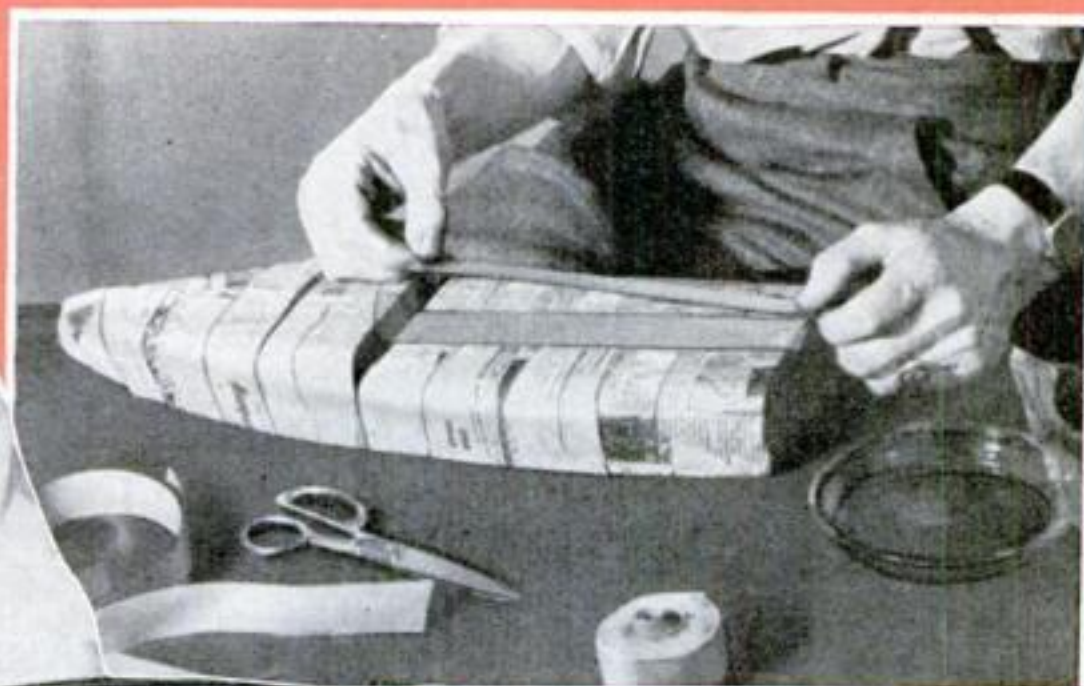
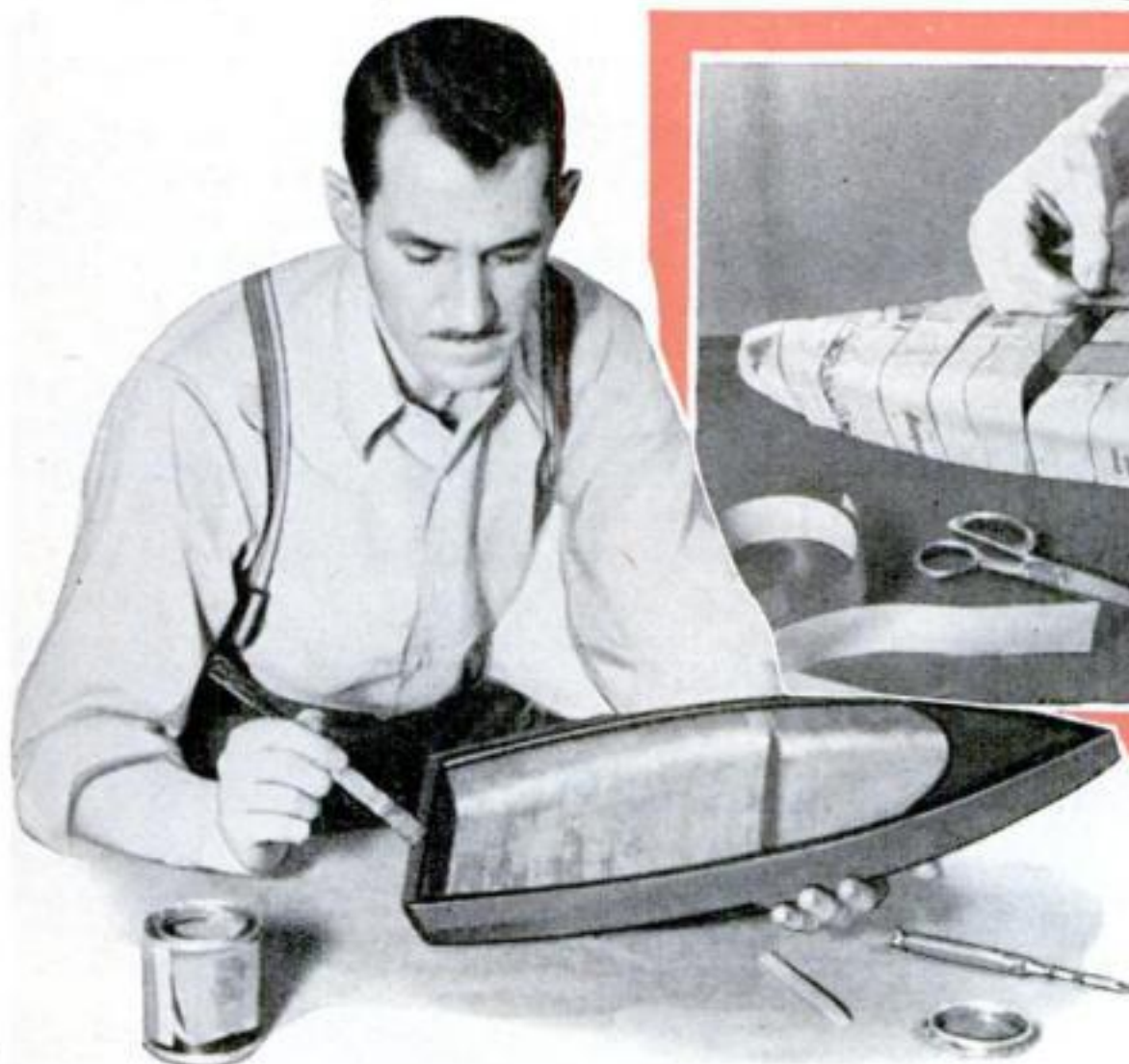


Fig. 2



Shape of the form, and how the hull is reinforced. Below, the completed hull will take a fine finish



Applying gummed paper to the three layers of wet newspaper covering the form, which had first been shellacked and then dried

ping them in water, lay them lengthwise from stem to transom, parallel to the keel. The strips should lap about one quarter of their width. The second layer of paper is put on diagonally over the form, and the third layer at right angles to the first diagonal layer.

Wherever the strips have a tendency to

pile up at any one place, shave them down while wet before putting on the next layer. Also add small pieces where needed so that approximately the same number of layers make up the entire hull. If the hull is 18" long—a good size for your first model—five or six thicknesses of the gummed paper should be sufficient to withstand all ordinary usage.

When the hull is completely dry, it should be smoothed up with sandpaper and given

two or three coats of paint. Sand each down.

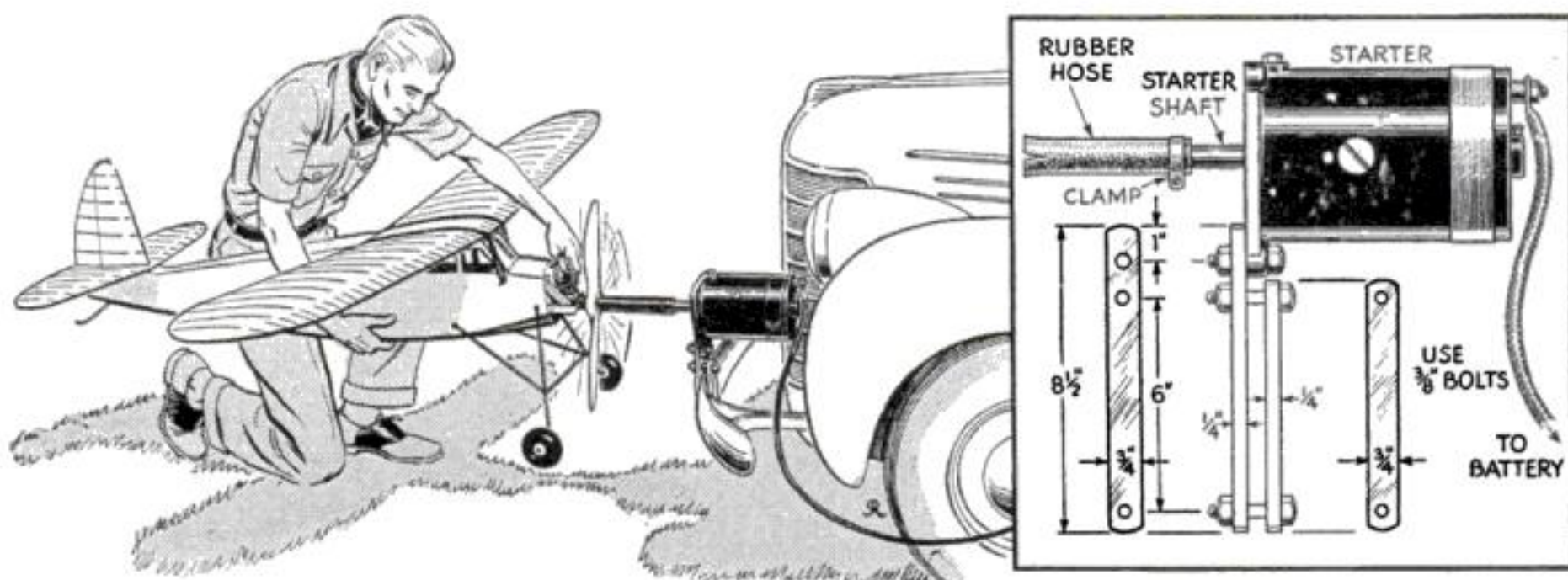
Next, remove the paper hull from the form. Strips of wood are glued to the hull along the edge, blocks are fastened to the bottom to hold the motor, and another block is placed at the "step" to take care of the propeller-shaft tunnel. If you have used a wooden transom, brads should be driven in around the edge to hold it in place. Stick

additional strips of paper over the heads of the brads to cover them, and repaint.

The inside of the hull should be finished with two coats of varnish. Be careful that all corners are covered, because any place left exposed will absorb moisture and ruin the hull.

With this method several duplicate hulls can quickly be made for competitive racing.

Electric Starter Spins Model Airplane Props



THIS electric starter for model airplane gas engines will overcome the starting troubles usually encountered at model-airplane meets.

An old 6-volt auto starter motor is obtained and reconditioned. A piece of garden hose 6" long is securely fastened to the starter shaft with a hose clamp, then split back about 1" at the other end so it will flare out and fit over the nut on the propeller shaft. The starter is clamped

securely as shown to the bumper of an automobile, to which it is grounded, and the cable, which should be heavy enough to carry about fifty amperes, is clipped to the car battery.

The flyer holds his model plane in position with one hand so the propeller hub presses against the hose on the shaft of the starter and then uses the other hand to adjust the gas needle. A plane motor usually starts in a few seconds.—ARTHUR C. STROHM.

Painted Scene Sets Off Miniature Railway Layout

ANY ordinary model-train display can be made more attractive and realistic by a painted background showing scenery. The background illustrated was painted by a professional sign painter on a piece of oilcloth 3' high and 8' long (the length of the layout). Brown, dark green, and tan show-card colors were used in depicting the mountains, and blue in several shades and white completed the sky. While the paint on the mountains was still wet, artificial snow was sprinkled on to give a snow-capped effect. Large travel posters often provide suitable scenes.—C. E. B.



Displays become much more realistic when backgrounds are added



More than 5,000 toys were made by the Long Beach club. At extreme right is Edward Aherl, 84, who painted 1,000 of the toys by hand

THREE Guild Clubs WIN NATIONAL AWARDS

IN RECOGNITION of their excellent work, **POPULAR SCIENCE MONTHLY** is awarding large silver plaques to the three home workshop clubs that led the National Homeworkshop Guild during the past season in the fields of civic activities, craftsmanship, and programs for club meetings.

The award for civic activities goes to the Long Beach (Calif.) Homecraftsmen's Club. Its 110 members constructed 5,010 toys for distribution to poor children through the Christmas fund of a local newspaper and 359 additional toys for the Salvation Army, a Mexican mission, and special cases. The club also made shipping boxes for bandages and clothing sent to Finland and Poland, first-aid splint sets for the American Red Cross, game boards for the social room of a church, and envelope

The Saginaw Homecraft Club presented its entry in the form of a beautiful album, having veneer pages on which were photos and a description of the project



containers for 100 pews in another church.

The Timbercraft Homeworkshop Club, New Bedford, Mass., wins the craftsmanship plaque through the efforts of Charles

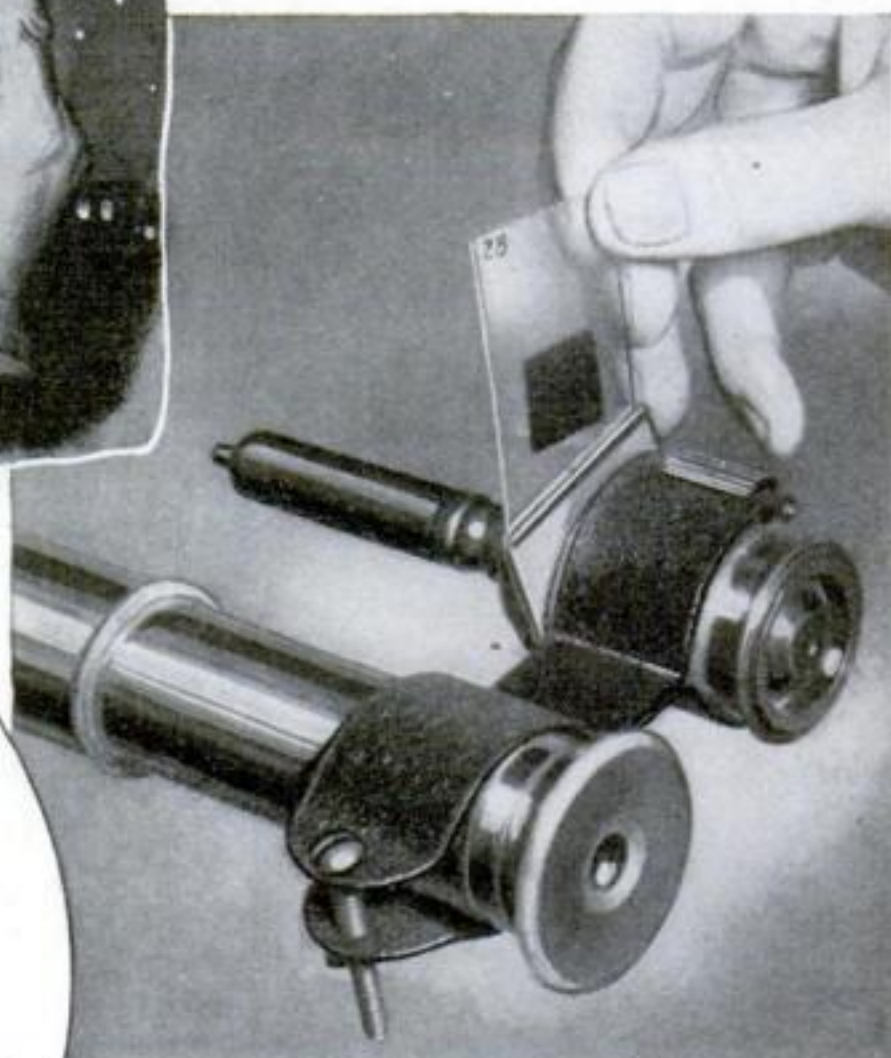
Jeglinski, its secretary, who designed and built the nautical chest described elsewhere in this issue. Mr. Jeglinski will receive a special craftwork medal for his work.

In the program division of the contest, the Portland (Ore.) Homeworkshop Club carries off first honors. That club was the subject of a recent feature article (*P.S.M.*, June '40, p. 164). By means of its high standard of programs and an extensive publicity campaign, it has built up a large and active membership.

FIRST IN CIVIC ACTIVITIES
Long Beach (Calif.) Homecraftsmen's Club
FIRST IN CRAFTSMANSHIP
Timbercraft Homeworkshop Club,
New Bedford, Mass.
FIRST IN CLUB PROGRAMS
Portland (Ore.) Homeworkshop Club
HONORABLE MENTION
CIVIC ACTIVITIES—Ashtabula (Ohio) Homecraft Club, Columbus (Ohio) Homecraft Club, Saginaw (Mich.) Homecraft Club
CRAFTSMANSHIP—Bison Homeworkshop Guild, Buffalo, N. Y.

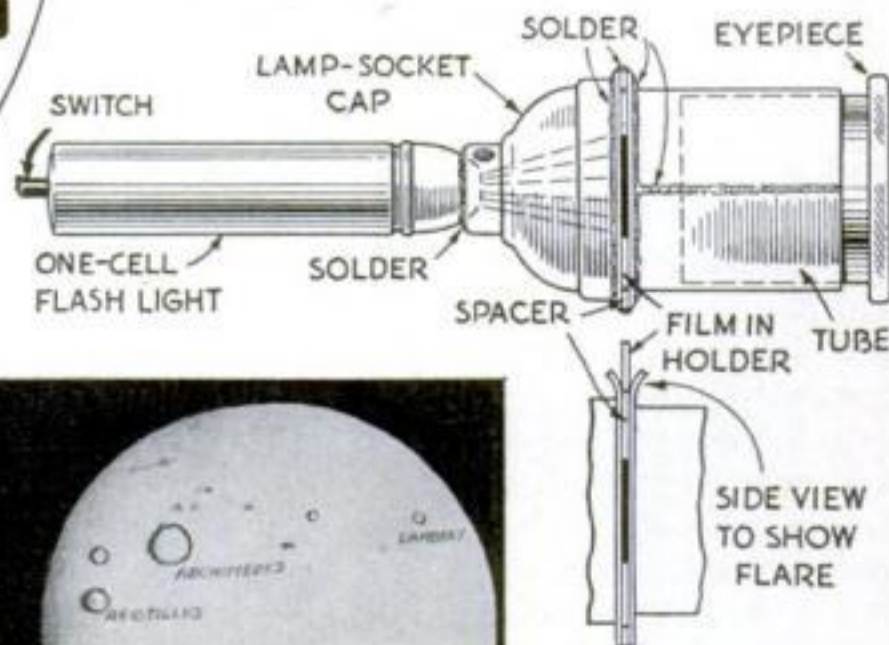


Below, inserting a film in the viewer. Left, by turning on the flash light, the image is compared with the actual object. The designer of the device is a distinguished amateur astronomer

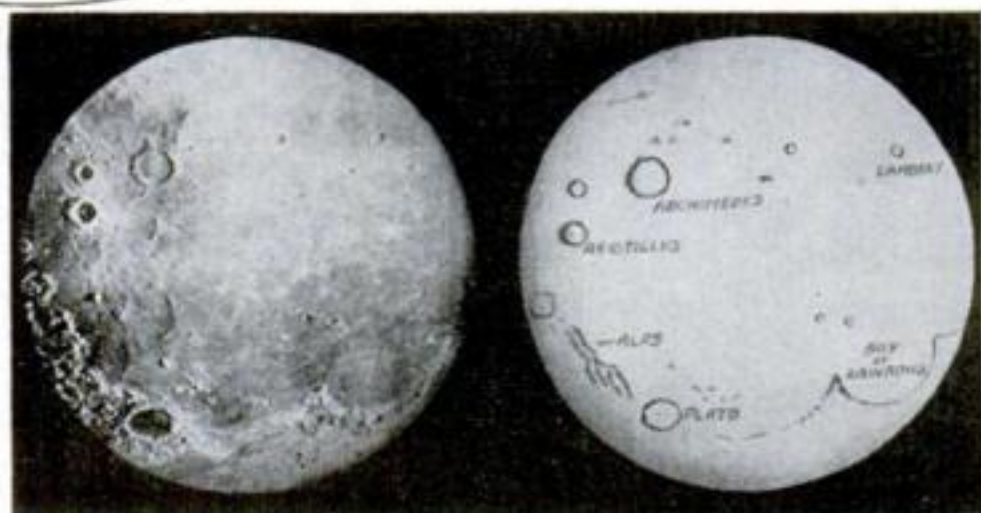


SIMPLE Film Viewer Identifies Celestial Objects

By
L. C. PELTIER



ASTRONOMERS, both professional and amateur, find it very difficult to point out to others some particular object in the heavens, especially through the telescope. The simple little device shown, however, will unerringly point out a special star in a field full of stars of similar appearance.

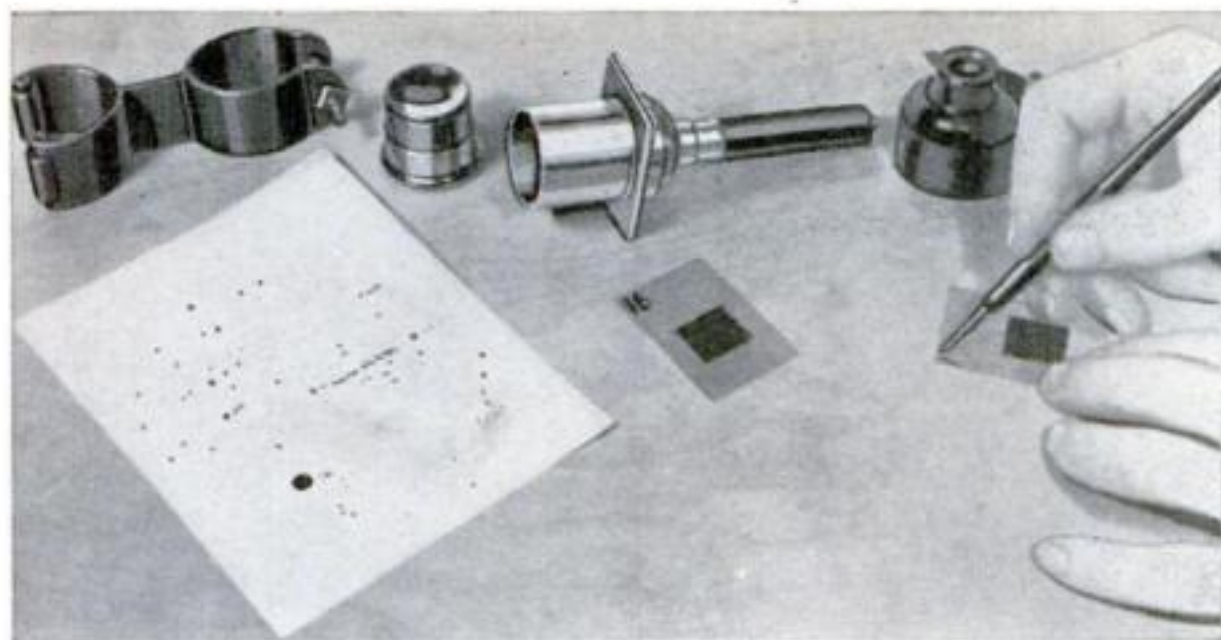


Left, object and chart should appear alike in size

It consists of a metal film holder to one side of which is soldered a tube for holding a magnifier or eyepiece, and to the opposite side is soldered a small flash light. A flashlight clamp such as is used on automobile steering posts holds the device on the telescope tube so that the observer can see

through both telescope and viewer at the same time. A greatly reduced photograph is made of a chart or sketch of each region or object to be identified. This negative is placed in the holder, and the object seen in the telescope is compared directly with its corresponding film image seen by transmitted light from the flash light.

Owing to the great reduction, it is usually possible to make two or three transparencies



In making the photographic copy, practically any type of camera and film can be used. Each chart is numbered for easy identification

on one negative and then divide and trim them to size after development. It is, of course, best to make the copies to a scale which will correspond approximately with the telescopic view. For example, if the telescope shows the entire moon in one field of view, the transparency, when viewed through the magnifier, should show a moon of similar size. Standard astronomical charts can be photographed or you can draw your own.

Neon Lamp Tests Circuits in Home Laboratory

AN ORDINARY neon glow lamp is a very versatile test lamp for the home laboratory or shop. Used as shown, it will indicate which terminals are live, approximately what voltage is present, its frequency, and if D. C., its polarity.

The bulb is a 2-watt, 115-volt neon lamp costing 45 cents. It has been screwed into a 10-cent pigtail socket after the ends of the wires were stripped and tinned. In constant use for over three years on all voltages and frequencies, it has saved many hours of guessing, circuit tracing, and unnecessary shock.

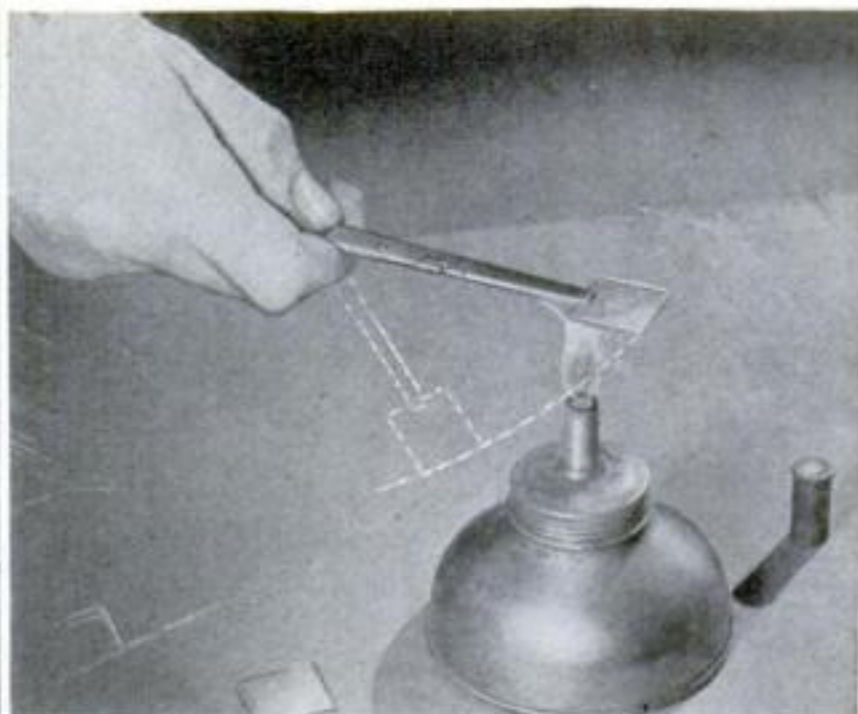
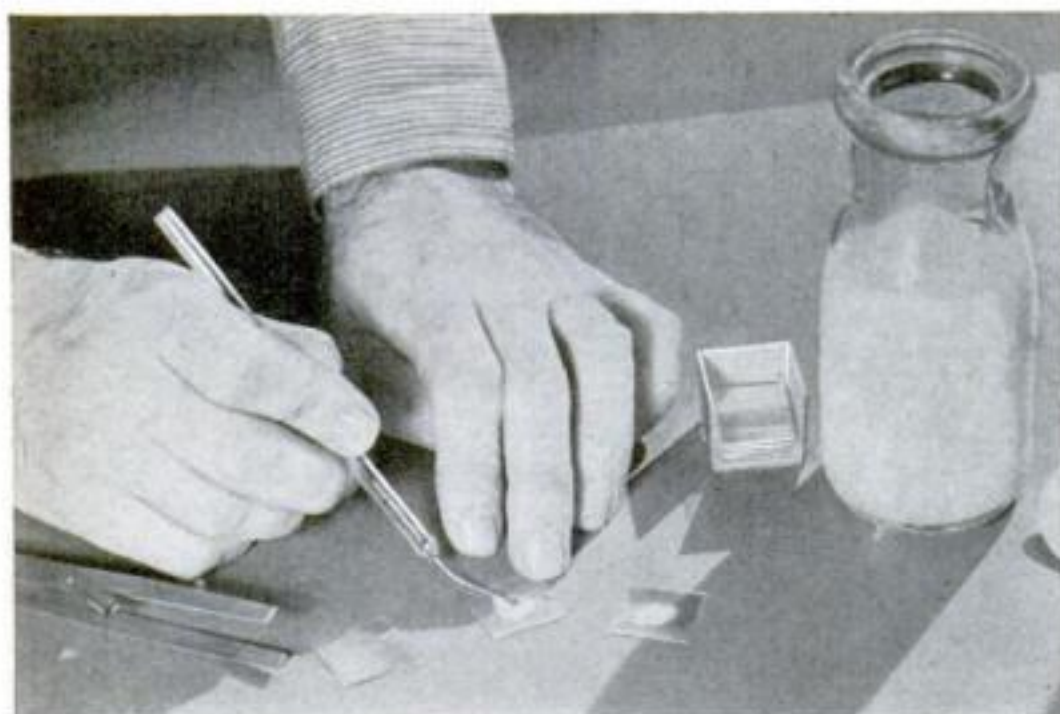
Unlike an incandescent lamp, the neon bulb may be used on voltages ranging from 70 to 550 volts without damaging the bulb, and it will light through resistances as high as 750,000 ohms for continuity testing. The approximate voltage present may be determined by the intensity and color of the neon glow, once you have noted the appearance of the glow under specific conditions. The frequency is shown by the way the plates light up. Sixty-cycle current shows as a steady glow on both plates, 25-cycle current has a very noticeable flicker, and on D. C. only the plate connected to the positive side of the line tested will become illuminated.

—R. B. STETSON.



No Fooling—Oily Rags Are Really Dangerous

EVERY home worker has been told many times not to leave oil- or paint-soaked rags around his shop or laboratory, but it is difficult to understand how great the danger is until a fire actually starts, and then it may be too late. The accompanying photograph, taken by a contributor to this department, shows the burnt remains of an apron used by a high-school student. He had been finishing a project on the lathe by rubbing it with linseed oil, and unthinkingly rolled up the oil-soaked rag in his apron and placed them in his desk drawer. The building custodian found the smoldering apron four hours later and extinguished the fire.



HOW TO PREPARE BACTERIA SLIDES

1 Spread bacteria-laden material (here, sour milk) on clean glass with the aid of a platinum loop

2 Kill and fix bacteria by holding the glass for a second at a time three times in an alcohol or gas flame

STUDYING BACTERIA

By MORTON C. WALLING

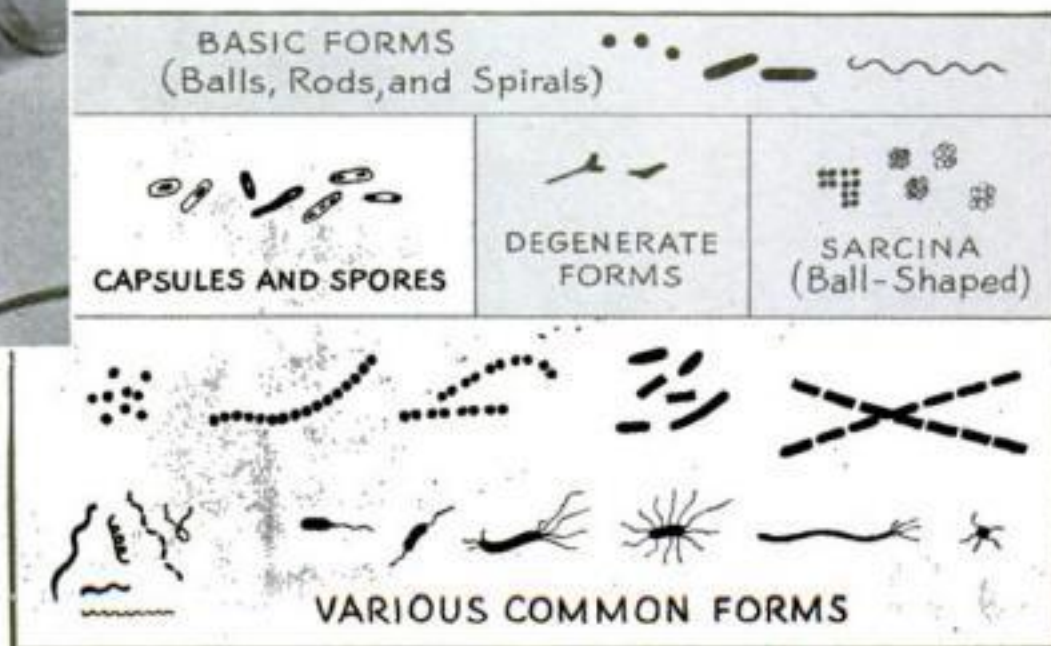
BACTERIA, the tiny plants that are the smallest and yet one of the most important of all living organisms, provide a fascinating and adventurous subject for the amateur microscopist. Of the many different types, some are vital to our existence, while others are destroyers of human and other animal life. But all are interesting for microscopic study.

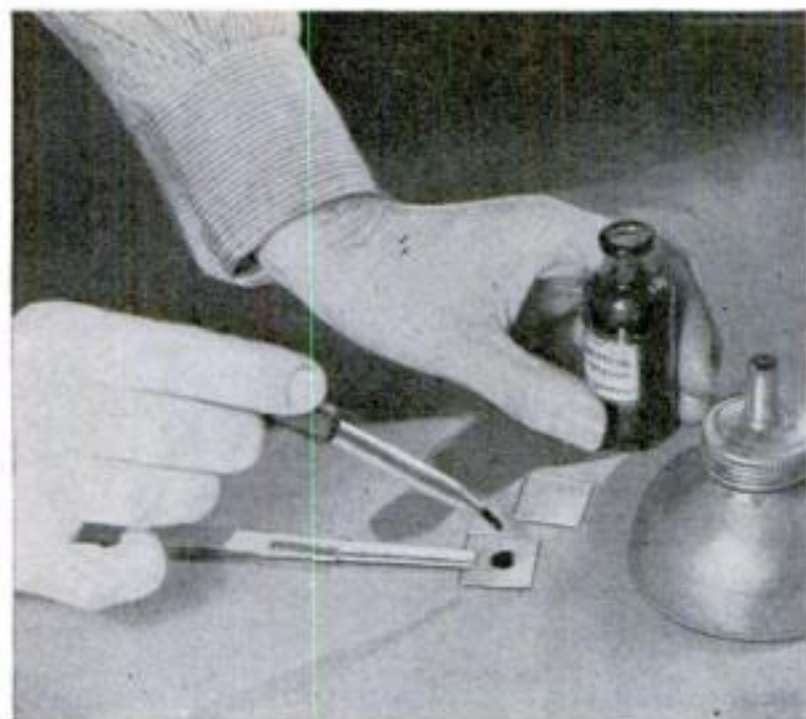
Where can you find a supply of bacteria for examination? The closest source is your own mouth, for if you touch your tongue to a microscope slide, or scrape your teeth with a toothpick, you'll have a ready supply of microorganisms for examination under your lens. Bacteria may also be obtained from raw milk, buttermilk, finger-nail dirt, decayed matter, chicken livers, and a hundred other sources.

The organisms are so tiny, however, that



Principal types of bacteria you will see under your microscope are shown in the diagram at right. The sooner you memorize them, the more fun you'll have

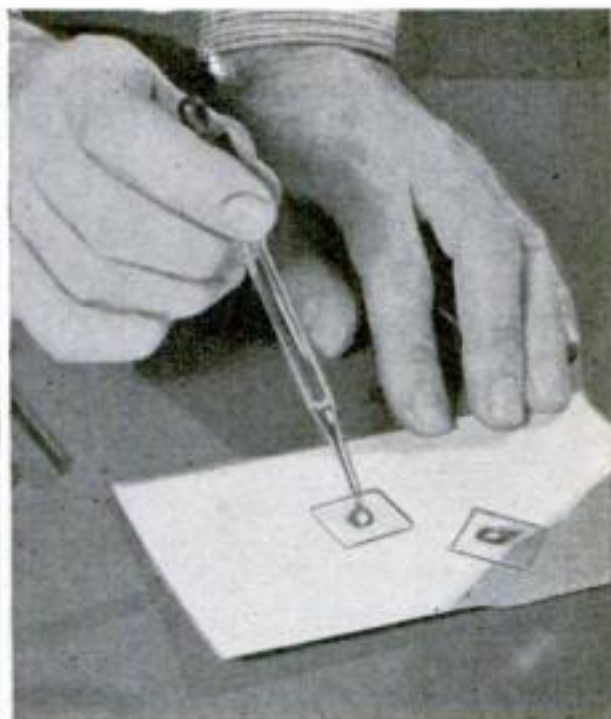




3 Dissolve fat away with xylol, then drop dye solution on the specimen. Heating speeds up dyeing



4 After staining, rinse the glass in water to remove the excess dye



5 If microscope shows it over-stained, add a little alcohol and quickly rinse with water

with Your MICROSCOPE

they must be specially treated to make them more visible under your lens. This is accomplished by the process of staining. The first step, however, is to kill and fix the organisms.

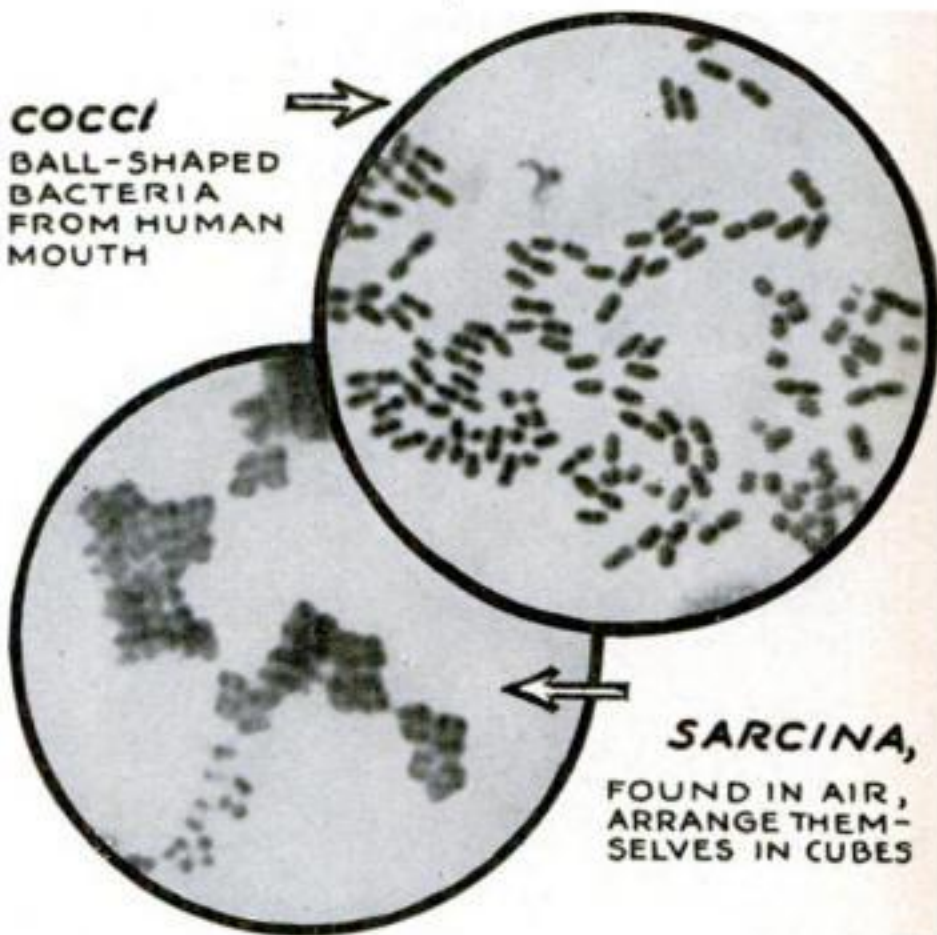
One of the simplest and most widely used methods of fixing is to spread the bacteria-containing material, to which water may be added if necessary, in a thin film on a clean microscope slide or cover glass. Let it dry. Then grasp the glass with tweezers and pass it, bacteria side up, through the flame of a bunsen burner or alcohol lamp three times, taking about one second for each passage. All bacteria will then be killed and fixed, and you are ready for the next step, staining.

There are many stains suitable for bacteria, some of a general type to make any bacterium easy to see, and others of a selective type to color some bacteria and not others, thus helping the microscopist to tell one from the other. At first you probably will find it sufficient to use a single, easily handled stain such as Loeffler's methylene blue.

To make this, mix thirty cubic centimeters of a saturated solution of methylene blue in ethyl alcohol, with 100 cubic centimeters of water to which two drops of ten-percent potassium hydroxide solution have been added. Now lay the slide or cover glass on a level surface and drop enough stain on it to cover the bacteria material. Let the stain act for from three to five minutes, and then rinse in clean water.

Often a dye will stain bacteria better if

COCCI
BALL-SHAPED
BACTERIA
FROM HUMAN
MOUTH



SARCINA,
FOUND IN AIR,
ARRANGE THEM-
SELVES IN CUBES

the glass is heated enough to make the dye solution steam, but not boil, as it is dropped on.

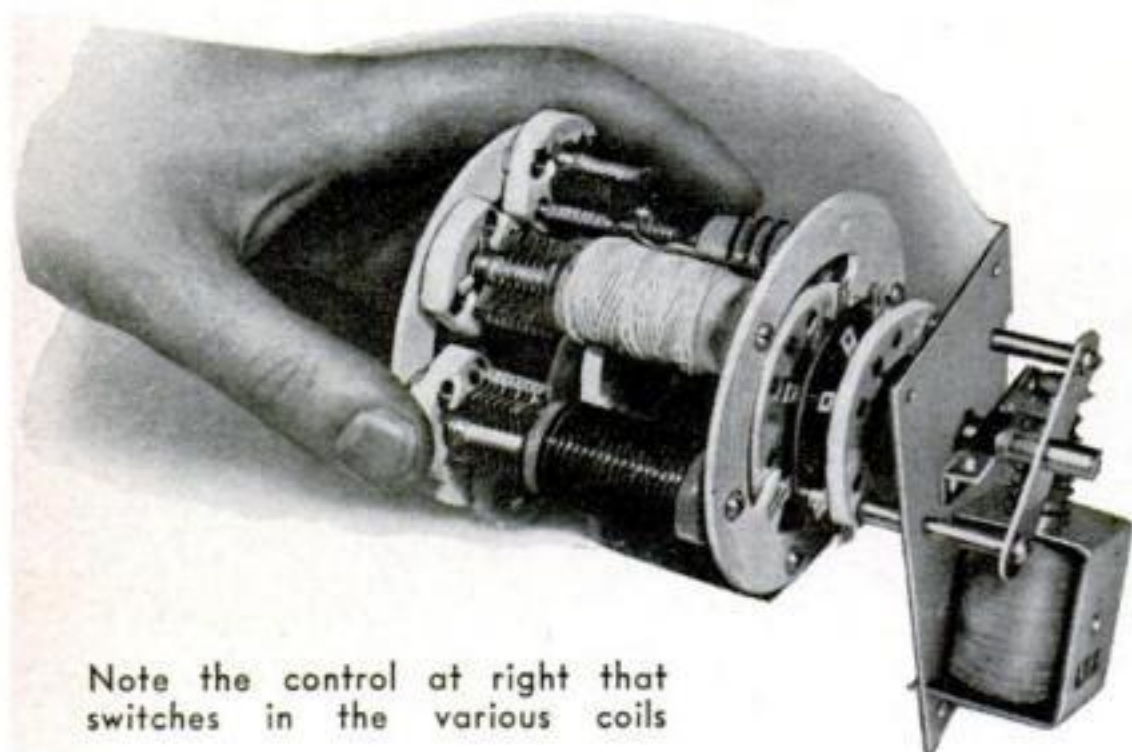
Having stained the bacteria specimen, you are ready to apply a cover glass, if your specimen is on a slide, or slide if on a cover glass. For permanent mounting, use neutral Canada balsam, readily available specially prepared for slide making. Place a drop of the balsam on the stained film and lower a thin cover glass in place on top of it.

In examining your slides under the microscope, refer to the drawings on this page or to a book on bacteriology to help you spot the distinctive shapes and arrangements of bacteria that reveal their identity.

Latest Aids for

Push-Button Switch Controls New Five-Coil Wave Unit

CONTROLLED by an electric push button mounted at any convenient spot on the transmitter panel, a compact set of five coils covering 10, 20, 40, 80, and 160-meter bands instantly switches over to any one of the bands when the push button is pressed. The time and trouble-saving device, shown in the illustration below, shifts bands through a magnetic or solenoid coil mounted on the assembly itself. The tuning coils are set radially around the unit, and each has its own midget 35-mmfd. tuning condenser which is pre-tuned for complete band switching.



Note the control at right that switches in the various coils

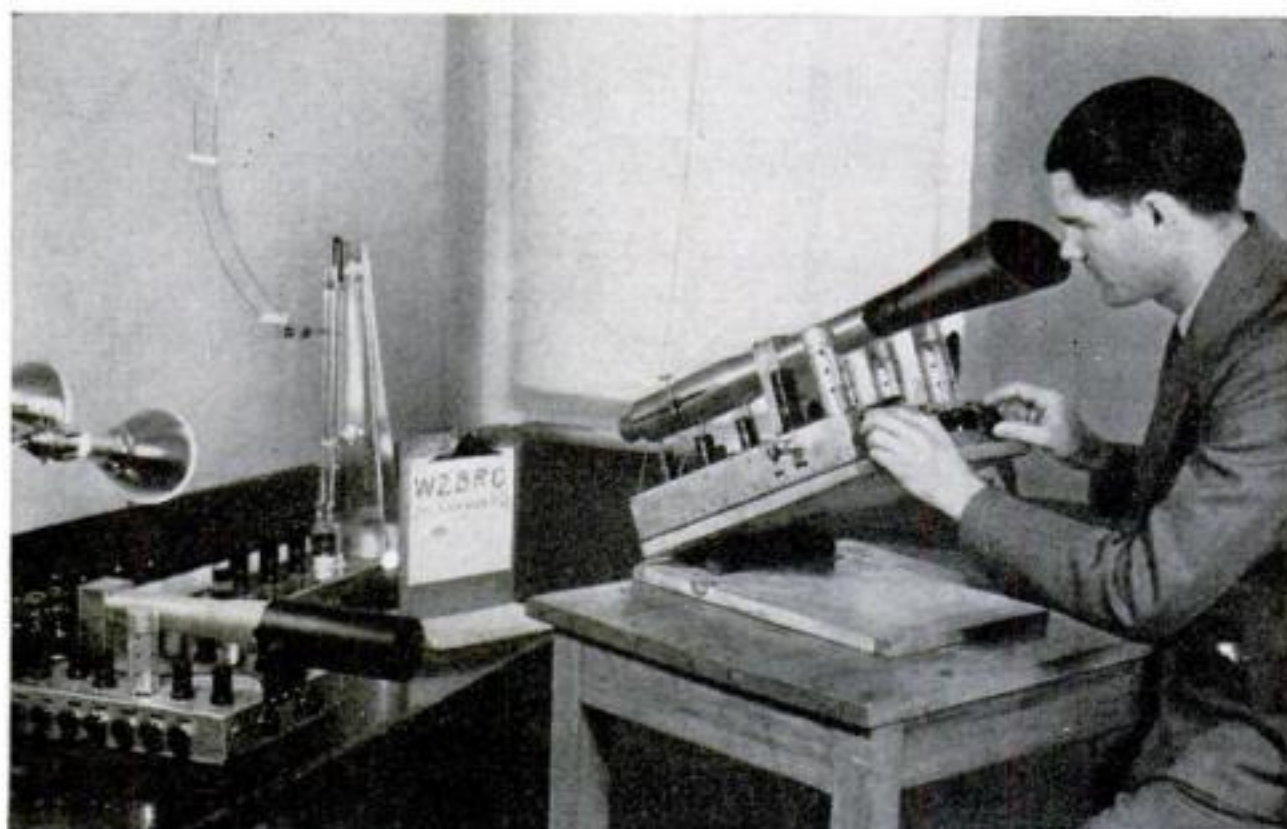


New Weighted Knob Simplifies Tuning

CALLED an inertia tuner, the knob shown above attached to the tuning shaft of a receiver is made of heavy metal and is two inches in diameter. Because of its weight and size, it continues to spin when given a twirl, thus reducing the amount of manual knob twisting necessary to swing between widely spaced wave lengths. The knob has a $\frac{1}{4}$ " hole to fit most tuning shafts. On either the main tuning or band-spread shaft, it gives a smoother touch to tuning.

Television Camera Tube for Amateurs

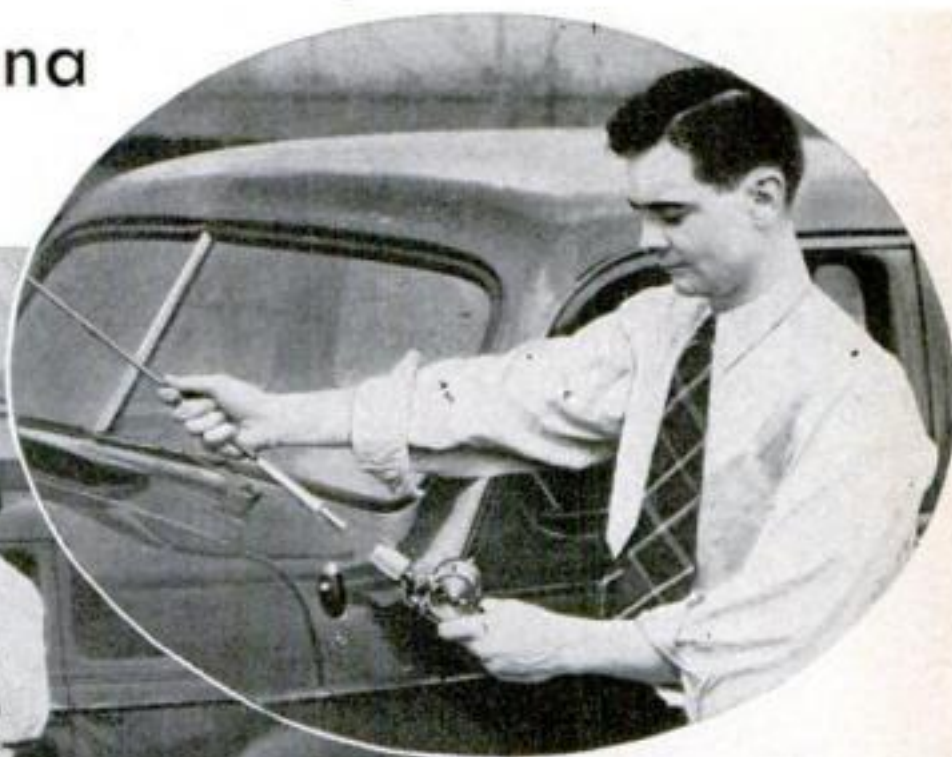
RADIO amateurs who would like to experiment with television transmission as well as reception can now do so with a new inexpensive television-camera "eye" tube just placed on the market. The new tube is capable of transmitting a television picture $1\frac{1}{2}$ " square composed of 120 lines. According to the law, anyone holding a radio amateur's license can operate an amateur television transmitter on the $2\frac{1}{2}$ -meter and shorter bands.



An amateur telecasting his call letters with the television transmitter

Radio Enthusiasts

Car's "Fish-Pole" Antenna Justifies Its Name



This South Bend, Ind., radio and fishing fan gets the most out of his equipment. His car radio's antenna slips out of its socket to make a fish pole

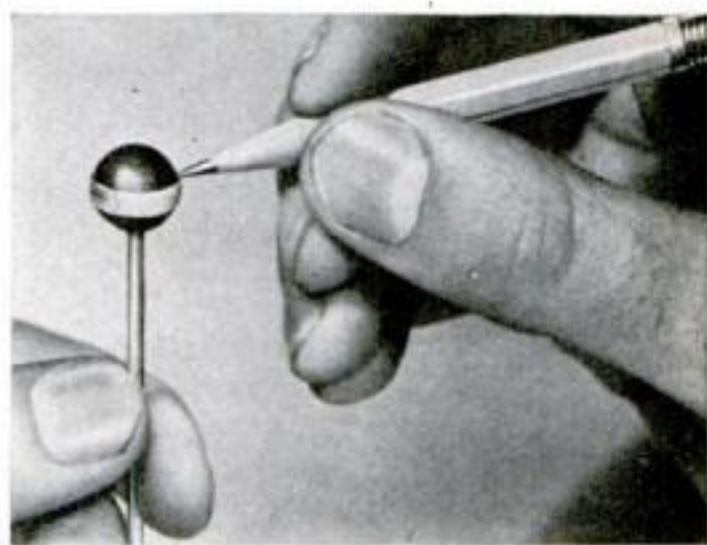
THE "fish-pole" antenna on the cowl of a South Bend, Ind., radio fan's car actually is a fishing pole. Finding it gave him good reception, he fitted a regular steel fishing pole in the antenna socket. Now, when he arrives at a stream, he removes the pole from the car, inserts it in its regular rod butt, and is ready to fish.

Spiral Jack-Cleaning Brush

DESIGNED for cleaning dust or corrosion from the insides of radio jacks, a small spiral brush that fits the chuck of an ordinary hand drill is now available. Inserted in the jack and revolved, it quickly wipes all surfaces clean.



One of these tiny brushes will clean out a jack in a jiffy



Static Muffler for Automobile Radio

STATIC electricity that ordinarily collects at the tip of pole antennas on automobiles, discharging with a violent crackling sound in the receiver, is said to be discharged gradually by the new antenna tip illustrated above. The static "muffler" consists of a small plastic ball girdled by a metal ring around its center. The metal ring, by allowing any static charge to leak off slowly, eliminates most of the annoying discharge noises.

Get Started in

WITH A FEW
INEXPENSIVE PARTS
YOU CAN BUILD SIX
CIRCUITS DESIGNED
TO TEACH THE TRICKS
OF SET BUILDING
AND REPAIR



Any good radio-supply store has the parts listed at the right. With them, you can build this circuit, and five more to be described in the next five issues

By **ARTHUR C. MILLER**

IF YOU have always wanted to experiment with radio, here's your chance. With the parts listed at the right, costing about \$8.95, you can build six modern radio circuits—six different radio hook-ups specially designed not only to use the same parts but to provide a good course in general radio construction and theory.

The first circuit, described in this article, is a simple two-tube all-electric earphone receiver. Next month, information on a three-tube all-electric earphone set will be given, and in succeeding months a four-tube speaker receiver, a three-tube phonograph amplifier, a three-tube tuned radio-frequency circuit, and a four-tube tuned radio-frequency receiver will be described. After purchasing the parts listed, together with the necessary connecting wire, fuse clips,

WHAT TO BUY

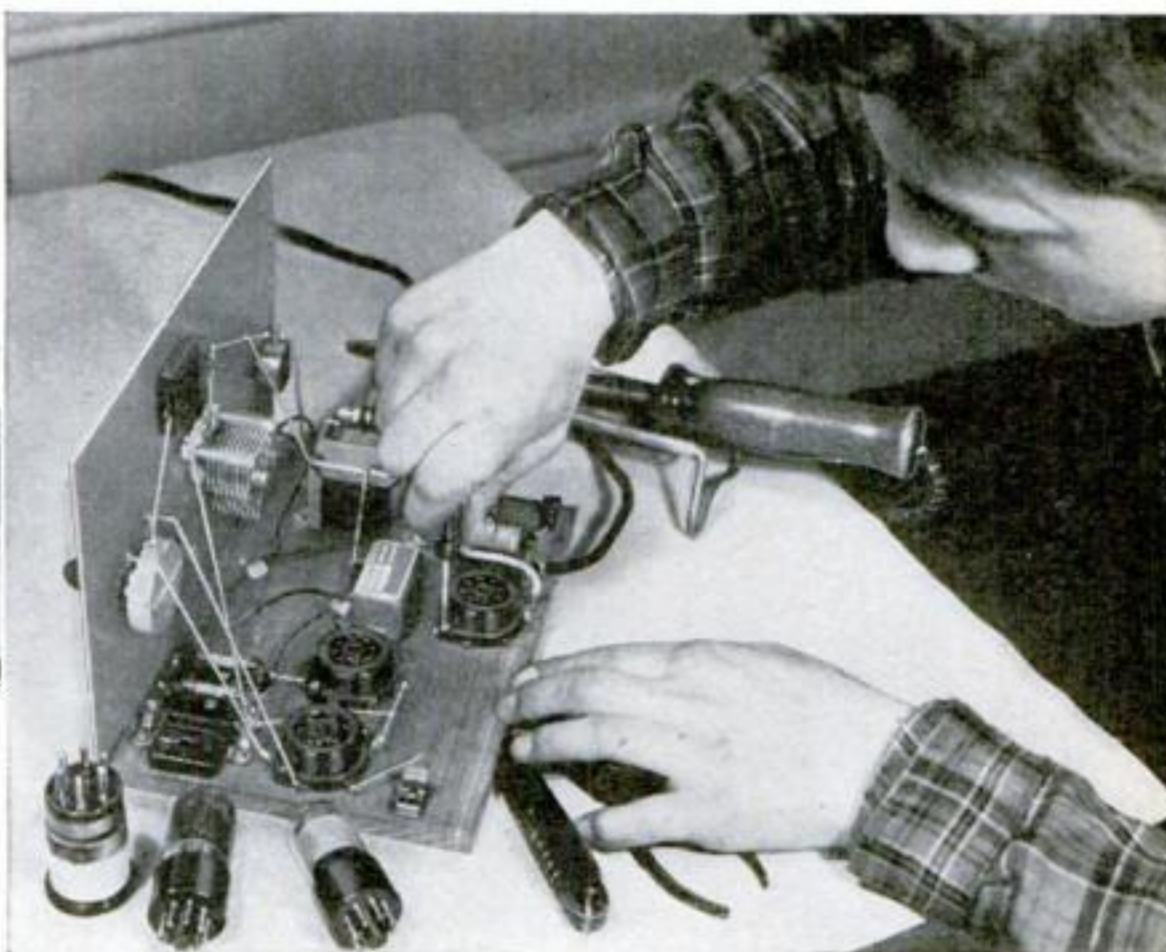
Line-cord, 135 or 160 ohm....	.29
Filter choke, 20 h., 500 ohm..	.29
Coils, plug-in, 100-570 meters (2)85
Variable condenser, .00014 mfd.55
Mica condensers (2), .002 mfd.42
Mica condenser, .0002 mfd....	.15
Mica condenser, .0005 mfd....	.15
Dual electrolytic condenser, 16-16 mfd., 250 v.....	.97
Shielded paper by-pass con- denser, .1 mfd., 200 v.....	.13
Tubular paper condenser, .006 mfd., 600 v.....	.07
Electrolytic condenser, 10 mfd., 25 v.....	.24
Pentode-triode tube, 25B8GT	.75
Pentode-rectifier tube, 70L7GT75
Carbon resistors (4), ½ watt, 1 meg.....	.40
Carbon resistor, ½ watt, 200,000 ohm10
Carbon resistor, ½ watt, 150,000 ohm10
Carbon resistor, ½ watt, 600 ohm10
Variable resistor, 25,000 ohm	.28
Variable resistor, 250,000 ohms28
Six-inch magnetic speaker....	.88
Four-inch dial.....	.26
Octal molded sockets (2)....	.48
Six-prong molded socket.....	.18
Rotary S.P.S.T. switch.....	.16
R. F. choke, 2.5 mh.....	.12
	\$8.95

◆ **TWO-TUBE ELECTRIC** ◆ **THREE-TUBE ELECTRIC** ◆ **FOUR-TUBE ELECTRIC**

Radio for \$8.95



A few of the items you need. At right, assembling a two-tube, all-electric broadcast-receiving set, the first in a series of six

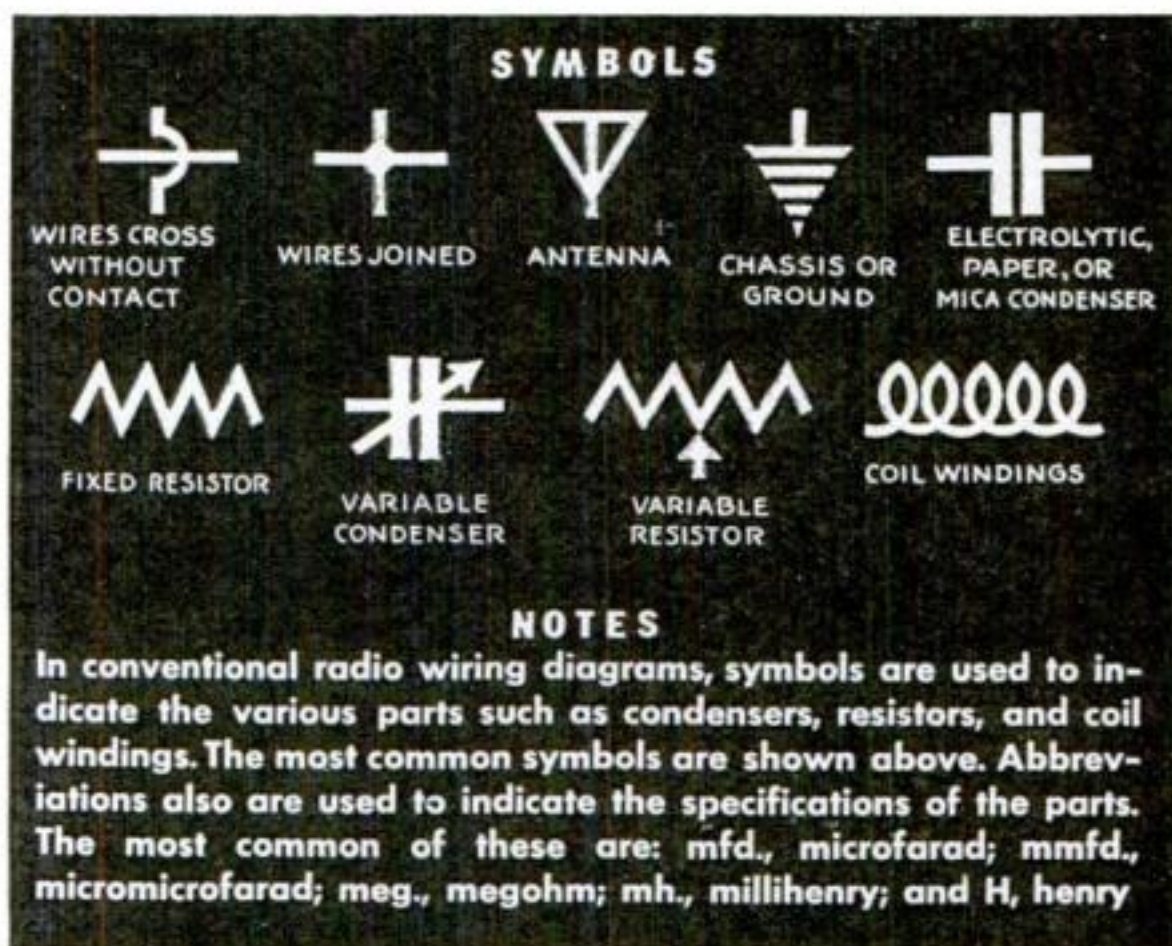


metal panel, wood base-board, and solder, you will have nothing more to buy.

Two tubes of the latest dual-purpose design provide all the tube elements needed in any one of the six circuits. The 25B8GT provides a high-frequency pentode and a high-amplification triode. The 70L7GT provides a half-wave rectifier and an output pentode. Both tubes have octal bases with eight pins or prongs.

Before going on to the construction of the first receiver, it will be well to review a few pointers on radio construction in general: First of all, use only high-grade parts and make sure that they match the specifications. Second, don't manhandle the parts—remember they have to last for six different circuits. Third, always keep your soldering iron clean and use a solder with a resin core.

The first receiver in this series of six is a two-tube outfit designed to operate on either alternating or direct current of 110 or 115 volts. For these voltages a line cord hav-



ing a built-in resistance of 135 ohms is used and is the right value for all six circuits. If the line voltage in your home is 120 volts, a 160-ohm line cord must be used.

In this circuit, the pentode section of the 25B8GT is used as a regenerative detector (the triode is not used) while half-wave rectifier in the 70L7GT supplies the rectified current for the receiver. (See next page.)

◆ PHONO AMPLIFIER ◆ THREE-TUBE TRF ◆ FOUR-TUBE TRF ◆

Pocket Receiver

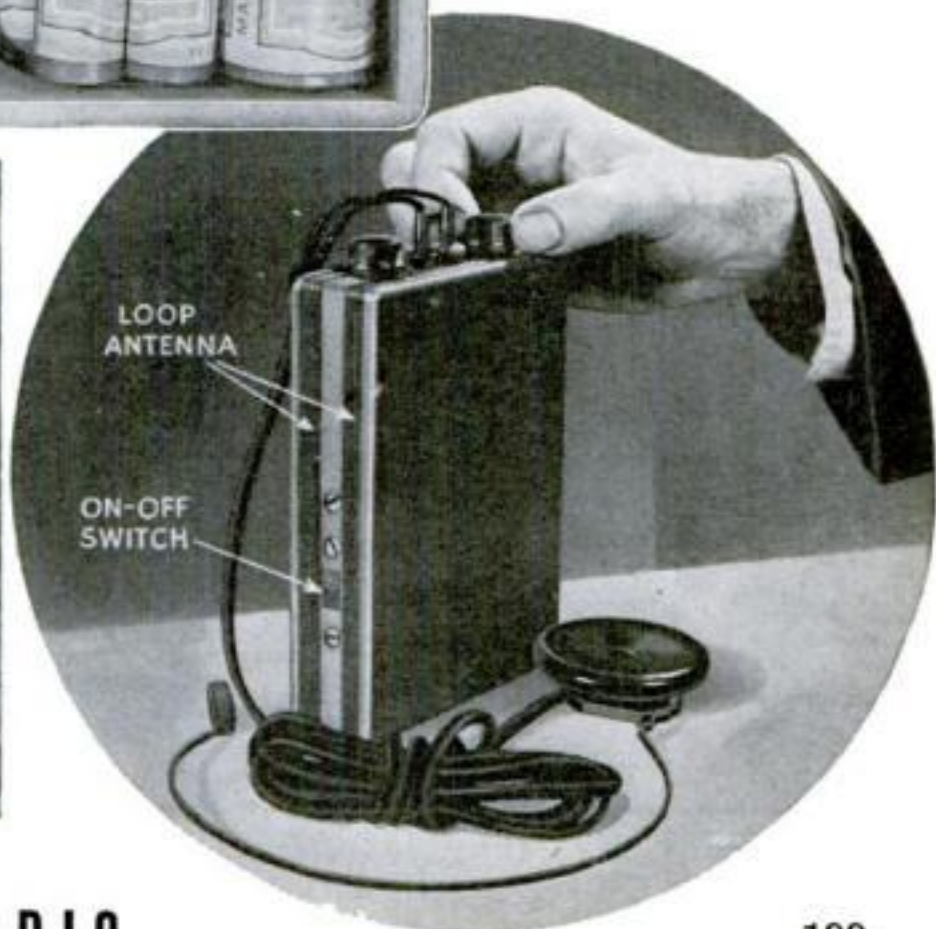
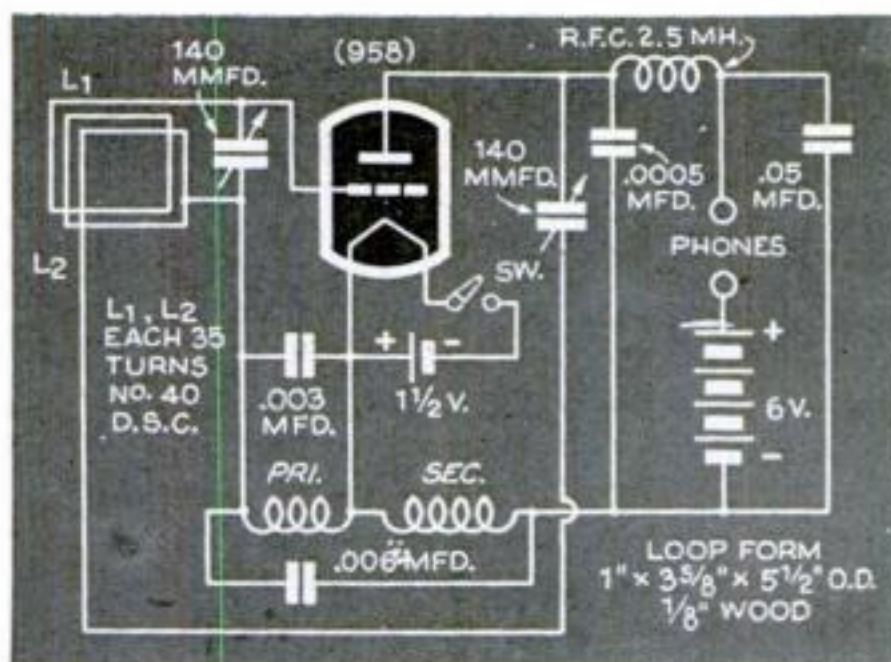
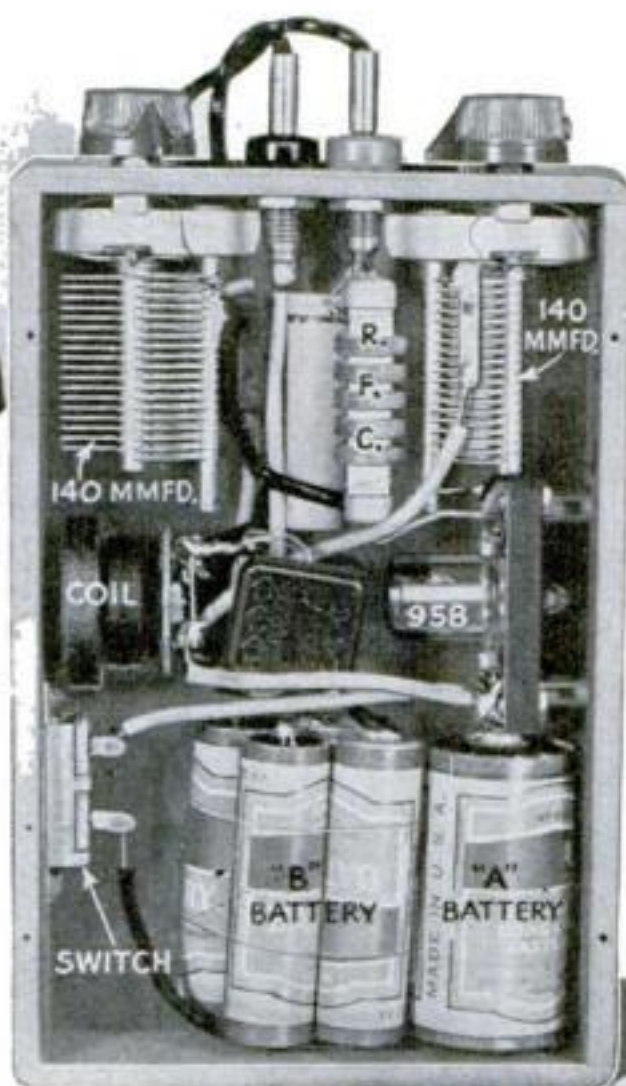
FOR SPORTS FANS



You can stow this midget receiver in a coat pocket. Note the parts arrangement at the right. Cigar-box wood forms the cabinet, and a loop antenna is wrapped around it, while flash-light cells to power the set are carried in the base

LITTLE larger than a tobacco tin, the pocket receiver pictured below is ideal for sports fans who want to hear the play-by-play broadcasts while watching a game or meet from the stands. The set employs a super-regenerative circuit, using a 958 tube that operates successfully on very low plate voltage. Around the cigar-box-wood case, a loop antenna is wound, consisting of thirty-five turns each side of center, with both sections wound in the same direction. Use No. 40 D.S.C. wire. The two 140-mmfd. variable condensers, of the air-padder type, should be mounted with screws before the loop is wound. A brass bushing $\frac{1}{4}$ " in diameter and $\frac{3}{8}$ " long is soldered to the stub

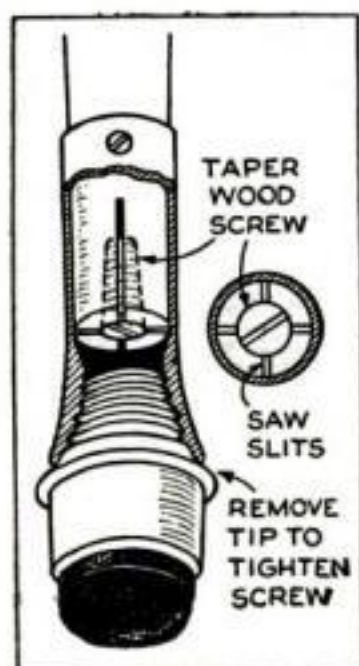
shaft of each condenser. A medium-size flash-light cell serves as an "A" battery, while the "B" is composed of four "fountain-pen" cells in series. The latter should last almost indefinitely as the drain is very small. Although the set is decidedly not a distance getter, since it has limited voltage and only a tiny directional loop, it should give good results up to fifty miles on the bands between 650 and 1260 kc.



Taper Wood Screws Keep Crutch Sockets Tight

ANYONE who uses crutches with sockets of the type shown knows how annoying it is when the wood shrinks and the loose sockets clank at every step. To cure this, I bought a couple of taper wood screws, removed the sockets from each crutch, and drilled a hole in the end of the wood a little

deeper than the length of the screws and a trifle larger than their small ends. Then I sawed two slits at right angles through the holes and as deep as the holes. I removed the part of the socket holding the rubber tip and placed the sleeve over the end of the crutch. A turn of the screw spreads the split end and holds the sleeve firmly.—A. J. PICOLET.

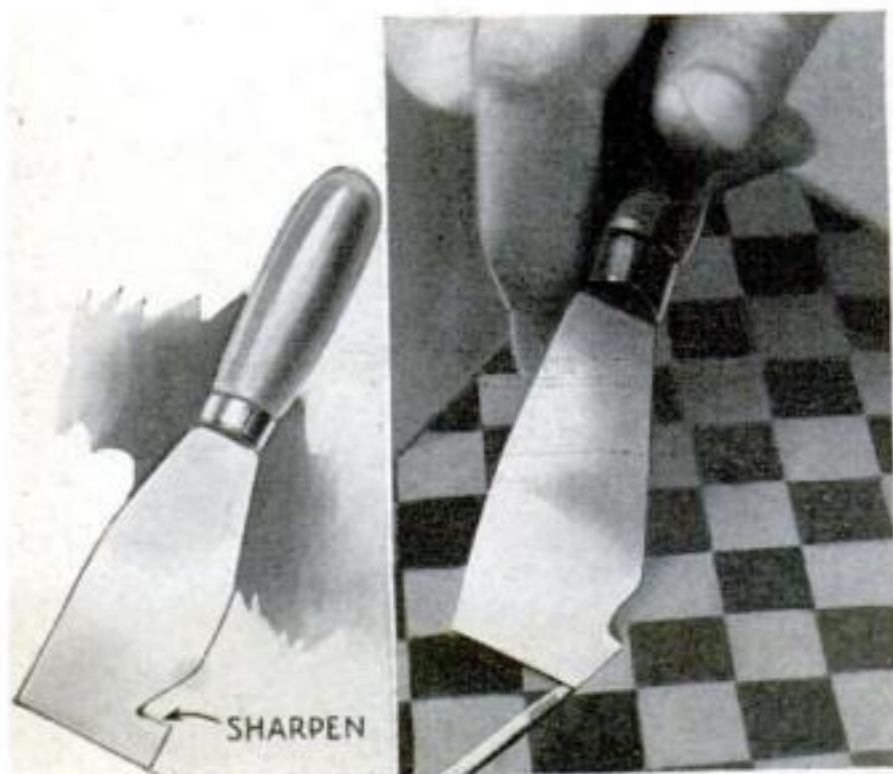


Heavy Burlap Sack Pads Edges of Hand Truck

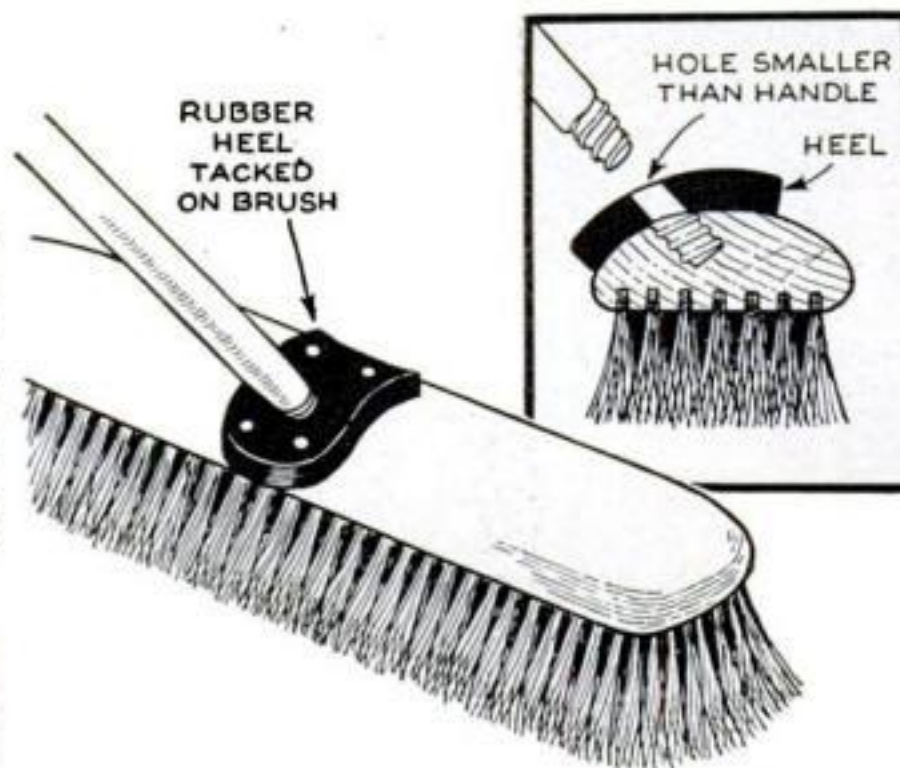
WHEN a hand truck of the two-wheel variety must be employed to move furniture, baggage, or any easily scratched merchandise about a warehouse, cut two holes in the bottom of a heavy burlap sack and slip this over the truck as illustrated.

Linoleum Cutter Made from Putty Knife

A LINOLEUM cutter can be made by cutting a notch near the end of a first-class putty knife. One edge of this notch is sharpened, and the knife is used as shown below. It has several advantages over an ordinary knife. Circles, squares, and other shapes can be cut as well as straight lines after you have had a little experience in manipulating the cutter.—WAYNE R. PIERCE.




The altered putty knife and method of using it. A sharp edge is necessary to cut a clean line



Rubber Heel Stops Brush Handle from Unscrewing

A SCHOOL janitor, who was inconvenienced because the handle of his horsehair floor brush often loosened and parted company with the brush, cured the trouble without the use of nails or screws by the simple method shown above. He tacked an ordinary rubber heel on the brush after cutting a hole through it somewhat smaller than the screw hole in the wood block. Forced into place through the rubber, the handle is firmly held by friction, no matter how long or vigorously the brush is wielded.

KODAK VIGILANTS



**"First family" of the
moderate-price camera
clan... eight models**

\$14⁵⁰ to \$42⁵⁰

PICTURES ARE BIG . . . 2½ x 4¼ inches with the Six-16's, 2¼ x 3¼ inches with the Six-20's. **FEATURES ARE MODERN . . .** Single push button for opening and closing. Waist-level and eye-level view finders. Retracting body shutter release. Extra-rigid lens support. **LENSES** are genuine Kodak Anastigmats. And the **SHUTTERS**, all highly accurate and reliable, include Eastman's new nine-speed Supermatic.

See these finest of moderate-

price folding cameras at your Kodak dealer's. Go over them "with a fine-tooth comb," and you will agree that rarely has so little money bought so much picture-taking ability.

. . .

PRICES: Kodak Vigilant Six-16, f/8.8 lens, \$16; f/6.3 lens, \$19.50; f/4.5 lens, \$29; f/4.5 Special lens, \$42.50. Kodak Vigilant Six-20, f/8.8 lens, \$14.50; f/6.3 lens, \$17; f/4.5 lens, \$25; f/4.5 Special lens, Supermatic shutter (illustrated), \$37.50 . . . Eastman Kodak Company, Rochester, N. Y.

GOING TO THE NEW YORK WORLD'S FAIR?—Take your Kodak—visit the Kodak Building—see the Greatest Photographic Show on Earth.

Only EASTMAN makes the KODAK

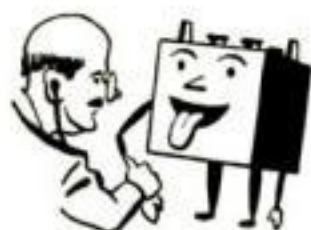
Announcing Willard DRY BATTERIES and FLASHLIGHTS

*New, Long lasting
batteries for all purposes*



● All Willard dry batteries equal or exceed U. S. Bureau of Standards specifications! Dated fresh at the factory. For your flashlights, radio or other use, ask for these new *More-for-Your-Money* Willards.

Safeguard Your Car against Starting failures



● Most starting failures are caused *not by the battery*, but by little things like worn or undersize cables, loose connections or faulty wiring that drain the life out of a perfectly good battery.

Your Willard dealer has a new Starting Service instrument that "X-rays" the entire starting system of your car—locates hidden "leaks" and flaws before they cause trouble. A Willard Starting Service check-up takes only a few minutes and will save you many a dollar—try it!

SEE OPPOSITE PAGE...

Willard

**YOUR ASSURANCE
OF QUALITY**



Small Trellis Opens to Fit Any Space

ADJUSTABLE for use in spaces up to 18' long, this trellis may be placed wherever a support for climbing plants is required and bolted to posts set at either end. The strips are sawed from a 1" board and are 1 1/4" by 4'. Holes for the rivets must be drilled accurately so the trellis will fold up compactly for storage. Finished with two coats of good white paint, the trellis will last for many years.—B. N.



Toothbrushes Converted into Tool Handles

WHEN the wooden handle of my draftsman's erasing knife split for the second time, I replaced it with a brilliant, clear, red-celluloid toothbrush handle. It took but a few moments to saw off the brush and drill a hole in the cut end to fit the tang of the knife snugly. A little celluloid dissolved in acetone was dropped into the hole, and the tang pressed firmly in. The idea was so successful that I have applied it to all the watchmaker's files on my bench. For larger tools, two handles may be faced off and cemented together with the acetone cement. Marks can be removed with a file and scraper. A beautiful polish may be obtained with a buffing wheel loaded with crocus or jeweler's rouge.—R. B. R.

New improved Willards give you **4** Extra advantages at NO extra cost!



LONGER LIFE

10-15% more miles and months —Former Willards were noted for power and long life, but these new Willards are still *better*. This year, Willard engineers have outdone themselves with a new, greatly improved line of batteries that give 10 to 15% longer average life than former Willards —and at *no* extra cost.

MORE RESERVE POWER

Plate materials increased 7-9% —Heavier elements go into each cell of the new Willard batteries—either thicker plates, heavier plates or more plates. That means not only more life but more reserve power. These new Willards easily handle the extra current demands of modern cars—and like it.

GUARANTEED CAPACITIES

You know what you're getting —Willard has clearly and permanently molded the guaranteed ampere hour capacity in the case of each new Willard battery. It's in plain sight. You *see* exactly what you are *getting*. And you pay *only* for what you get. It's a guarantee of *full* measure of battery value for your money.

"SAFETY-FILL" CONSTRUCTION

Stops Dangerous Corrosion

No acid spray on motor and wiring—With "Safety-Fill," your Willard battery never drinks too much. It's very simple. Very effective. This exclusive new device prevents overfilling—definitely protects your automobile against corroded cables and terminals that cause current

losses and unexpected starting failures.

Your Willard dealer has these NEW batteries now. Look for his red-and-white Willard sign, or the name Willard in the classified section of your phone book under "Batteries."

WILLARD STORAGE BATTERY COMPANY

Cleveland • Dallas • Los Angeles • Toronto

Willard

SAFETY-FILL BATTERIES



MORE BATTERY FOR YOUR MONEY!

**TOMORROW'S DRIVING
WILL BE**

**"Fluid-
Driving!"**

**A CHRYSLER
First
THEY'LL ALL FOLLOW!**



WHY SHIFT GEARS?

Drive the new and thrilling way . . . the *Fluid Drive* way. It's all fun and no work! You just touch the throttle to go . . . touch the brake to stop! *Fluid Drive* is the drive of tomorrow, but you can enjoy it in a Chrysler now. Try it . . . see your Chrysler dealer today.

★Tune in on Major Bowes, CBS., Thurs., 9 to 10 P. M., E. D. S. T.



SIMPLE AS THIS!

Air from a running fan will set an idle fan in motion, as a breeze turns a windmill. That's the principle of *Fluid Drive*.



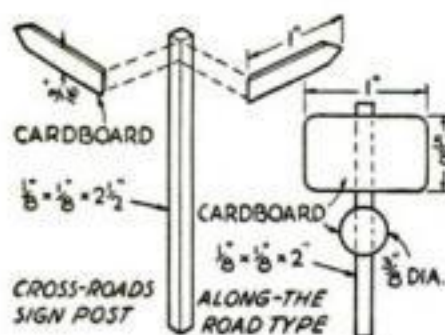
SMOOTH AS OIL!

One fan-like wheel drives another by forcing a current of oil against it. Smooth as oil, because it *is* oil. No rigid metal connections. Can't jerk.

be modern BUY CHRYSLER!



Two Authentic Signposts for Model Railways



ACTUAL signs were copied in making these model - railway accessories. The lettering is either applied directly to the signs, or first drawn much

larger on a sheet of paper and then copied with a camera. For those not adept at hand lettering, the second method has the advantage of minimizing any flaws.

Locate the crossroads signposts where roads intersect each other, and the along-the-road type between road intersections. Holes drilled in the platform or small tin squares nailed to the bottom of the posts will keep the signs upright. Both the signs shown in the drawings are scaled for "O" gauge.—C. ELMER BLACK.

Turning Wooden Rosettes

ROSETTES may be turned quickly on the lathe if a smooth board is first attached to the faceplate with a small brad projecting from it in place of a center screw. Start the lathe and hold a lump of rosin against the board over the surface to be covered by the rosettes. The friction will melt the rosin. Then hold the turning stock lightly in one hand, set it on the brad, and with the other hand press it down against the faceplate firmly but slowly. In an instant the rosin will melt between the surfaces and the rosette will stick. After the rosette has been turned, tap it with the handle of a chisel and it will drop off. Stick on another piece of stock and repeat the process without stopping the lathe.—J. J. EDWARDS.



RAILWAY EXPRESS — SYMBOL OF DEPENDABLE SERVICE... USES DEPENDABLE CHAMPION SPARK PLUGS!

IN CITIES AND TOWNS all over the United States, the familiar Railway Express truck is a symbol of dependable, speedy, safe delivery. Over 12,000 of these trucks are constantly on the go regardless of weather. Dependability is the watchword. This giant fleet has used Champion Spark Plugs for years. Here is just one more outstanding proof that Champions make every engine a better performing engine—one more sound reason for you to insist on dependable Champion Spark Plugs for your car.

Only Champion Spark Plugs have the Sillment seal which keeps them permanently free from troublesome leakage, common to ordinary sparkplugs. Since only one "leaker" in a set will cause rough, uneven, wasteful engine operation, it is obvious that Champion's leak-proof qualities are necessary to maximum performance and economy. Profit by the experience of the nation's largest and most efficient fleets—of the world's racing champions on land, water and in the air—by insisting on Champions for your car.

MODEL BUILDERS—ATTENTION!

ACTUAL SIZE
V-PLUG



65c

Champion Spark Plugs for model gas engines give the same dependable performance as the regular Champions. Sillment sealed. Sillmanite insulator. Alloy needlepoint electrodes for easy starting. One piece construction.

CHAMPION SPARK PLUG CO.
901 Upton Ave. • Toledo, Ohio

	V	V-2	V-3
Hex	1/2"	3/8"	5/16"
Thread	3/8"-24	1/4"-32	1/4"-32
Thread Length	7/32	7/32	5/32
Weight, Grams	8	3 1/2	2 1/2



Make More Things at Home with **KESTER** **METAL MENDER**

You'll get a real kick out of increasing your skill as a craftsman with Kester Metal Mender. You can build more things and make them better when you have a can of this handy home solder on your work bench. Time and again you'll find that the easiest way to make it is to *solder it!*

And the same thing goes for repairing anything made of metal. Kester Metal Mender contains its own flux and makes perfect, money-saving repairs every time. All you do is apply heat and the job's done.

Buy it at your hardware or other stores.

For a sizable free sample of Kester Metal Mender and "How-to-Use-It" Booklet—*mail coupon now.*



KESTER
METAL MENDER

..... You Can Paste this Coupon on a Postcard

Kester Solder Company, 4253 Wrightwood Ave., Chicago, Ill.

Please send me free sample of Kester Metal Mender and "How-to-Use-It" Booklet.

Name _____

Address _____

City _____ State _____

..... Mail the Coupon Now

TESTED BLUEPRINTS Solve Shop Problems

NO MATTER what type of project you intend to build, you will find that blueprints drawn to a definite scale and tested by experts will eliminate many of your workshop problems. For eighteen years we have been supplying amateur craftsmen with a wide variety of plans. Some of them are given below. A complete list will be sent upon receipt of a self-addressed, stamped envelope.



MODELS

Brig MALEK ADHEL, 20" hull, frame-and-plank or solid-hull construction, 304-305-306-R.....	1.25
Clipper Ship in a Bottle, 121-122.....	.50
Clipper Ship SOVEREIGN OF THE SEAS, 20½" hull, 51-52-53-R.....	1.00
Cody Coach, 13" long, 144-145-146-R.....	1.00
CONSTITUTION ("Old Ironsides"), 21" hull, 57-58-59-R.....	1.00
Cruiser U.S.S. INDIANAPOLIS, 12" long, 216.....	.25
New Bedford Whaleboat, with complete equipment, 14" long, 326-R.....	.50
Privateer SWALLOW, a Baltimore Clipper, 13" hull, 228-229-230-R.....	1.00
Racing Yacht, 20" Marconi-rigged sailing model, 48-R.....	.50
Spanish Treasure Galleon, 24" long, 46-47.....	.50
Trading Schooner, 17½" hull, 252-253.....	.50
U. S. Battleship TEXAS, 3' hull, 197-198-199-200..	1.00



BOATS

Cabin Cruiser, 17' long, weighs 750 lb., for use with outboard or inboard drive, 356-357-358-359-R.....	\$1.50
Folding Duck Boat, 13' long, 170-R....	.50
Fisherman's Outboard Boat, 9' 3" or 11' 6" long, weighs 115 or 160 lb., for motors from 3 to 16 h.p., can also be rowed, 344-345-R.....	.75
High-Speed Boat for Small Outboard Motors, 7' 11" long, 257-R.....	.50
Inboard Boat, 15' long, weighs 325 lb., for motors from ½ to 5 h.p.; can also be rowed, 384-385-R.....	.75
Midget Boat or Pram, 9' long, for oars, sail or outboard motor, 339-R.....	.50
Motorboat-Rowboat, 13' long, with decked hull, for use with outboard or inboard drives, 147-R.....	.50
Plywood Dinghy, 9' 7" long, weighs 60 to 75 lb.; can be rowed, sailed, or used with small outboard motor, 387-388-R.....	.75
Racing Sailboat BLACKCAT, 13' 4" long, weighs 250 lb., Marconi rigged, 321-322-323-R.....	1.00

(Continued on page 208)





You may worry about the neighbor's kids

but here is one worry you can avoid

If those little rascals next door get your goat, there's not much you can do about it except change your address.

But you don't have to move to get Peace Of Mind about your chassis lubrication.

Let us Marfak your car every 1,000 miles, and be sure it is in perfect running condition.

For Marfak is Texaco's standardized 40-Point Lubrication Service. Every detail is checked. Nothing missed.

And at every vital friction point, a special lubricant goes on duty—a lubricant so tough it lasts twice as long as ordinary grease.

This lubricant is Marfak, from which the full service takes its name.

To keep your car in smooth-as-velvet condition, drive in and we'll do the rest.

TEXACO DEALERS INVITE YOU TO tune in the TEXACO STAR THEATRE—Starring Kenny Baker and Frances Langford—Every Wednesday Night—Columbia Network—9:00 E.D.T., 8:00 E.S.T., 8:00 C.D.T., 7:00 C.S.T., 6:00 M.S.T., 5:00 P.S.T.

Let us
MARFAK
your car



Copyright 1940
The Texas Company

TEXACO'S 40-POINT LUBRICATION SERVICE AT ALL TEXACO AND OTHER GOOD DEALERS



P. W. RESETS BATHROOM FIXTURES

You can quickly and easily reset loose bathroom fixtures, loose tiles, seal unsightly cracks around bathtubs and sinks with water-proof Plastic Wood. At Paint, Hardware, 10¢ Stores. Try it!



PLASTIC WOOD



Hardware dealers
Write for proposition

NEW!

Saves Time
Saves Work
Saves Fingers

Markwell BRADMASTER

For driving and placing brads in difficult corners. Fills a long-felt need for Airplane Model makers, builders, carpenters, electricians, auto and radio mechanics, handy men, window trimmers, home craftsmen. You need it! Send only \$1.00. Order from:

MARKWELL MANUFACTURING CO., (Dept. PS 1)
200 Hudson Street New York City



Plans for the Workshop

(Continued from page 206)

Sectional Rowboat, 9' 8" long; can be used with small outboard, 340-341-R.....	.75
Sport Runabout, 9' 8" long, for small outboard motor, weighs 100 lb., 309-310-R.....	.75
Utility Rowboat, 13' long; can also be sailed or driven by outboard motor, 224-R.....	.50



FURNITURE

Colonial Writing Desk, 3' 6" high and 3' 8" long, 21.....	.25
Combination Bench and Tilt-Top Table, (no turning), 11.....	.25
Fireplace Screen (brass and wrought iron), Bed-side Cabinet, and Trinket Box, 389A.....	.25
Gate-Leg Table, 3' 6" diameter, circular top with leaves up (no turning), 24.....	.25
Modernistic Stand (24 3/8" high) and Bookcase (70 1/2" high), 88.....	.25

Illustrated Leaflet Tells How to Cut and Drill Glass

SIMPLE ways to cut and drill glass are described in a new, four-page, illustrated leaflet just issued. It contains full directions for cutting window glass, wire glass, mirrors, and the like; tells how to cut disks and odd shapes and how to remove the tops of bottles; describes easily made tools for drilling holes; and explains how to prepare ground glass. The price is only fifteen cents. Send your order to the Blueprint Service Department.

Sewing Cabinet of 1812, 178A.....	.50
Tavern Table and Scroll Mirror, 105.....	.25
Telephone Table and Stool, 18.....	.25
Tilt-Top Table, 20" by 24" top, 249A.....	.25



RADIO

Amateur Short Wave Receiver, three tubes, battery or 110-volt A.C. or D.C. operation, 155.....	.25
Amplifier, Three Stage, 42.....	.25
Beginner's Battery Receiver, 365A.....	.25
Five Tube Short-Wave Set, midget receiver with loudspeaker, A.C. or D.C., 223.....	.25
One-Tube Receiver, battery operated, 103.....	.25
Screen Grid Receiver, 109.....	.25



MISCELLANEOUS

Automatic Lighthouse Night Lamp and Pelican Design Sewing Kit, 255A.....	.25
Bird and Animal Patterns, 56.....	.25
Electric Train, Horse, and Doll House, 14.....	.25
Perpetual Star Chart, 214.....	.25
Projector for Photo Prints and Pictures, 259A.....	.25
Sandpaper Cabinet, Saw Horse, Tool Rack, Hand-Screw Rack, and Machinist's Hand Vise, 368A..	.25

POPULAR SCIENCE MONTHLY 353 FOURTH AVENUE, NEW YORK

Send me the blueprint, or blueprints, numbered as follows:

I am inclosing.....dollars.....cents

Name.....

Street.....

City and State.....

(Please print your name and address very clearly)

12" All 'Round Lathe for Wood and Light Metal Turning



**Swings 12" Over Bed
37" Between Centers**

• This No. 1465 Delta 12" Ball Bearing Lathe is designed to give you the biggest amount of **real lathe** for the least money! It has many splendid features including: Rigid, fine-grained cast iron bed with accurately machined ways; improved, convenient Self-Indexing device; Lubricated-for-life sealed ball bearings; Universal Tool Support, rigid yet easily adjustable; Full 1 1/4" spindle with 5/8" hole; 4 speeds for wood turning or 16 speeds for metal work (with simple counter shaft arrangement); Inboard and outboard spindles threaded to take face plates; Efficient, powerful V-Belt drive; Safety headstock with covered belt and pulley. For the complete story of this outstanding lathe, including specifications and prices, fill out coupon below.

**Inside
Secrets
of Delta Quality**

"DIAMOND BORING"

• All holes on Delta machines, where precision must be maintained, are "diamond bored." Here's why: It is physically impossible to produce a perfectly round hole by drilling and reaming alone. A drilled hole may actually be oval in shape, slightly larger at one end, rough in surface and not true to size. Reaming corrects some of these troubles, but, as the reamer follows the drilled hole, the reamed hole will be "off" if the original hole is not true.

Diamond boring as performed on special machines in the Delta plant, is the finest method known in modern machine shop practice for producing perfectly accurate round holes and precision fits. All ball bearing seats in Delta tools, for example, are diamond-bored to size. Since the diamond-bored hole is perfectly round, perfect in size and mirror-like in surface, the fit of the bearing is held to close tolerance and is absolutely uniform and snug. Contrast this with the fit of a bearing in a drilled hole, or a rough bored hole, where the bearing is held only by the "high points" of the metal in the hole, and consequently frequently becomes loose in service.

"Diamond-boring" is but one of the many precision operations that make Delta machines the finest you can buy.

Send for Latest Delta Catalog

A complete guide book to power tools which not only lists the complete line of Delta "Quality" wood and metal working tools—but shows you the important points to look for in all power tools. It illustrates and explains the advantages of the many hidden features of design and construction that make for long, better service in power tools. (Also send for Project Book No. 7 crowded with new projects, including working drawings, photographs and full instructions.)



Delta Manufacturing Company
600-634 E. Vienna Ave.
Milwaukee, Wis.

Gentlemen: Send me the latest Delta Catalog listing the complete line of Delta Lathes, Circular Saws, Band Saws, Jointers, Scroll Saws, Shapers, Sanders and Drill Presses.
☐ I enclose 10c (stamps or coin) for which please send me the new Delta Project Book No. 7.

Name

Address

City State

☐ Check here if you are a Delta user now. (Dept. B940)

Delta MFG. CO.

600-634 EAST VIENNA AVENUE
MILWAUKEE, WISCONSIN



MACHINE SHOP MEN

Learn to set up and run ANY kind of machine; MAKE MORE MONEY NOW by learning quickly HOW TO DO THINGS which usually take years of study and practice! The demand for SKILLED men is ALREADY ahead of the supply, then what WILL IT BE a month or two from now?

Needed NOW!

Bigger Pay Don't miss this chance to qualify for promotion, don't miss this Big Opportunity which is yours almost for the asking. Eight Big Books chockful of important mechanical facts told simply and clearly. Over 3000 pages, nearly 3000 illustrations cover every subject fully, including Tool Making, Pattern Making, Foundry Work, Mechanical Drawing, Forging, Machine Shop Practice and Management, and hundreds of other subjects.

8 Big Books (1940 Edition) Sent FREE

to you for examination. Decide in your own home or place of business whether or not you want to keep them, check up on any facts you want to. Note their great MONEY MAKING value, then, if you want them, pay on the easiest kind of payments. Send NOW and we will include a year's consulting membership in the American Technical Society without extra charge—and also a Big Binder of nearly 800 pages with 267 original shop tickets with 1200 illustrations. These show, step by step, how to set up and run any kind of job and are in addition to the 8 books.

American Technical Society, Publishers—Home Study Courses.

American Technical Society, Dept. 5620, Drexel at 58th St., Chicago. You may send me the 8 big NEW books and binder of shop tickets for free examination. I will pay the few cents delivery charges only, unless I decide to keep them in which case I will send \$2.00 in ten days and \$3.00 per month until the total price of only \$34.80 is paid. If I return them in 10 days I will owe you nothing. Because I send now you agree to give me a membership in the American Technical Society entitling me to consulting privileges with any of your experts for one year.

Name.....

Address.....
Please attach a letter stating age, occupation, employer's name and address and that of at least one business man as reference.



SHAW DU-ALL GARDEN and SMALL FARM TRACTOR

Does ALL JOBS on small farm—small jobs on ALL FARMS. Three types: 2-wheel garden tractors 3, 4, 5 H.P.; 4-wheel 5 and 8 H.P. Riding Tractor; High arch models, 8 H.P. Write for FACTORY prices—FREE CATALOG.



Air-cooled engines; auto-type gear shift; many fine features.

SHAW MFG. CO., 5709 Front St., Galesburg, Kans.; 5812-PS Magnolia Ave., Chicago, Ill.; 130-PS West 42nd St., New York City; 668-PS North 4th St., Columbus, Ohio



GOOD TOOLS NEED GOOD OIL

When you work with tools, they must be in working condition. 3-IN-ONE Oil keeps tools clean and bright. It oils the working parts; protects against harmful rust and tarnish. Get it at Hardware, Drug, Grocery, 10¢ Stores.



3-IN-ONE Oil



Miniature War Fleet Built with Our Kit

TWO new United States superdreadnoughts, the *Washington* and *North Carolina*, slid down the ways and into the sea several weeks ago. Now nearing completion, one or perhaps both of these much-discussed battleships will be commissioned into the U. S. Navy next year. You can build a small model of either vessel and eight other fighting craft with our kit No. 7M. The price is only \$1.50 (\$1.75 west of the Mississippi or in Canada) including a booklet giving complete instructions and full-size drawings.

The "miniature fleet" consists of a superdreadnought, light cruiser, aircraft carrier, submarine, and five destroyers. The scale is 1" equals 100'. No special tools are required so the project is ideal for the long summer evenings, and will also create considerable interest among your friends.

If you prefer a large model, we suggest building a 3' model of the battleship *Texas* with Kit No. E. The price is \$7.45 (\$7.95 west of the Mississippi or in Canada).

Construction kits are also available for other models. Send a stamped, self-addressed envelope for an illustrated price list. Address POPULAR SCIENCE MONTHLY, Dept. 90A, 353 Fourth Avenue, New York.



Kit E Battleship "Texas"

FREE Stove Catalog

Factory Prices



New streamline designs! New features! 136 Styles and Sizes. Coal Wood Ranges; Combination Gas-Coal or Oil Ranges; Electric Ranges; Oil Ranges; Oil Heaters; Coal-Wood Heaters; Furnaces. 30 Days Trial. 24 hour shipments. 1,600,000 Satisfied Users. Stoves \$3 Down, up to 18 months to pay.

"A Kalamazoo Direct to You"

KALAMAZOO STOVE & FURNACE CO., Mfrs.
721 Rochester Avenue
Kalamazoo Michigan

Ready Now

New TRAILER PARTS Catalog

and TRAILER BUILDERS MANUAL-25 cents

80 Illustrated Pages packed with ideas and suggestions for Trailer Builders, Buyers, and Owners. Largest and most complete line of Trailer Parts, Supplies and Equipment at America's Lowest Prices. Rush 25c (in U.S.A.) for this book today. Satisfaction guaranteed!

TRAILER SUPPLY CO., BOX 360-B, WAUSAU, WIS.



60 POWER TELESCOPE... \$2.19

VARIABLE EYEPIECE 20X-40X-60X
NEW! Three telescopes in one. 3 different magnifications. 20 power for ultra-bright images with 40 and 60 power for extra long range. Guaranteed to bring distant objects, people, sports events, ships, moon, stars, etc., 60 times as close.

Most powerful made for anywhere near the money. Closes to less than a foot in length. Multiple lens system. 30 mm. objective lens. 5 sections. Directions included for using as a compound 4 lens microscope. American made. Prompt shipment guaranteed. We pay the postage. Only \$2.19.
BROWSCOPE CO., Dept. 69, 5 W. 27th St., New York, N. Y.



Carved Hull Kits—Separate Fittings Model Yacht Fittings—Sails & Spinnakers

Send 20c coin for illustrated catalog

A. J. FISHER 1002-8 Etowah Ave., S. Royal Oak, Mich.

USED Correspondence Courses

Complete home-study courses and educational books, slightly used. Sold, rented, exchanged. All subjects. Money-back guarantee. Cash paid for used courses. Full details and illustrated 72-page bargain catalog FREE. Write today!
NELSON COMPANY
500 Sherman, Dept. J-202, Chicago



Earn Cash at Home!

We paid M. M. \$1174 for exceptional "cellar crop" SNOW-KING mushrooms! Big free picture book tells if your cellar, shed, barn suitable. We furnish materials, buy all crops thru our 25 branches. Established 1908. Write today.
United Co., 3848 Lincoln Ave., Dept. 342, Chicago.



GIVES YOU Accuracy Strength and Power at Low Cost

Now you can handle any of those precision metal lathe jobs that used to require expensive equipment—the new Atlas 6" lathe is the first precision-built small lathe at a popular price. Timken bearing equipped, 16 speeds, V-belt drive, precision-ground bed. 12" or 18" centers, \$61.50 and \$64.50 complete less motor. Send for big 1940 Atlas catalog.

ATLAS PRESS CO.

955 N. PITCHER ST.

KALAMAZOO

MICHIGAN

Atlas

LATHES • DRILL PRESSES • ARBOR PRESSES
METAL SHAPERS • VISES • CIRCULAR SAWS

BENJAMIN AIR PISTOL WITH HAND PUMP

Made in U. S. A.



For Target—Small Game—Camping—Etc. Guaranteed—Accurate—Practical—Economical—Safe—Clean—Quiet. Adjustable Force—Amazing Maximum Velocity. No Smoke or Fumes. Bolt Action—Hammer Fire—Hair Trigger—Safety Lock—Hand Pump. Single Shot BB \$8.50; Single Shot cal. 177 or 22 with rifled barrel \$8.50; BB 8-Shot \$10.00; Holster \$2.00. Also a complete line of Benjamin Genuine Compressed Air Rifles for BB and cal. 177 or 22. No license required from dealer or factory. Write today for complete specifications and free targets.
BENJAMIN AIR RIFLE CO. 852 Marion St. St. Louis, Mo., U.S.A.

BE THRIFTY...use ROGERS GLUE

for woodworking and household repairs... incredibly strong. Send for FREE blueprint plans for making useful articles.
ROGERS • Dept. A-1 • Gloucester, Mass.

WHEN YOU BUY FLASHLIGHT BATTERIES DEMAND "EVEREADY" FRESH DATED BATTERIES

The word "Eveready" is the registered trade-mark of National Carbon Co., Inc.



"BUILD-YOUR-OWN"

Just couple your own engine to this unit, mount it on chassis and you have money making advantage of a portable welder at a saving of \$300 to \$500.



"Build-Your-Own" Unit

30 DAY'S TRIAL
AT HOBART'S RISK
AND EASY
"PAYS FOR ITSELF"
TERMS

Free! VALUABLE BOOKLETS ON WELDING. CHECK YOURS AND MAIL THE COUPON TODAY.
☐ How to "Build-Your-Own"
☐ New Profits in Arc Welding
☐ New Arc Welding Catalog

New low prices make this profitable welding service available to everyone. Opens doors to big pay jobs that carry real profit. Hobart Welders are easier to operate, faster, guaranteed to bring you quality welding business... extra profits will pay for welder without expense to you.

NO INVESTMENT TERMS—PROFITS PAY FOR IT

Extra earnings and savings possible with Hobart Welders make it easy to own without expense. You can even rent a new Hobart and later purchase it without loss. Coupon brings details.



HOBART

THE FASTEST SELLING ARC WELDER ON THE MARKET TODAY

HOBART BROS., BOX P-940, TROY, OHIO

Gentlemen: Send me information on () Build Your Own Welder () Electric Drive Welder () 30 Days Trial, Easy Terms () Rental Plan. Also send me free books I've checked.

Name

Address

NEW **SHOOTING THRILL!**
SAVAGE
MODEL 6 AUTOMATIC
CAL. .22 LONG RIFLE \$16²⁵

15 SHOTS as fast as you can pull the trigger! Shoots Regular or High Speed Cartridges. 3 rifles in one. Can be used as (1) Automatic—(2) Hand-operated Bolt-Action Repeater—(3) Single Shot. Handsomely finished American walnut stock.

SEND FOR FREE CATALOG
 Showing complete line of Savage Sporting Arms

SAVAGE ARMS CORPORATION
 Dept. 2601 UTICA, N. Y.



STOP BACKTRACKING

Don't let confused directions put you on the wrong road. Drive by compass and avoid backtracking. The Hull Stream-line Auto Compass is a positive guide at all times. Attractive Bakelite case, genuine sapphire bearing, built-in compensator. Only \$2.95 at your dealer. Write for information.



HULL MFG. CO., P. O. Box 246-E9, WARREN, OHIO



FREE BOOKLET ON MICROSCOPY

You'll enjoy Microscopy as a personal hobby. Free booklet tells how to begin. Also describes Bausch & Lomb Amateur Microscopes (\$14.50 up). Write today.

BAUSCH & LOMB, 370 Bausch St., Rochester, N. Y.

MOTORSCOOTERS and MIDGET CARS


BUILD YOURS! Easily Constructed. We furnish highest quality parts at low prices. Assemble your own at low cost. Make extra money building for others. Send 10c for complete plans and literature on wheels, tires, motors, transmissions, clutches, etc., for building scooters, midget cars and other vehicles. **HONSAKER, Box 7000, Masontown, Pa.**



TRAILER BUILDERS' GUIDE & CATALOG only 10c

Build a Trailer easily in spare time with world's best line of trailer parts, axles, hitches. Complete working blue prints only 50c. Universal Draw Bar, readily attached to any car. **SEND 10c TODAY FOR CATALOG.**

HAMMER BLOW TOOL COMPANY, Dept. D-9, Wausau, Wis.

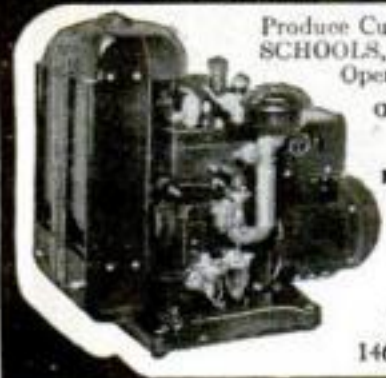


ONAN ELECTRIC PLANTS
ALTERNATING AND DIRECT CURRENT

Produce Current, same as City Power Lines, for FARMS, SCHOOLS, THEATRES, PUBLIC BUILDINGS . . . Operate Lights, Radios, Motors, All Appliances.

Over 40 STOCK MODELS—350 to 50,000 Watts.
 Any Voltage—Any Frequency.
 Combination A. C. - D. C. Types.
 Manual, Full Automatic and Self-Starting. \$99 up.
 Shipped—COMPLETE, READY for OPERATION.
 THOUSANDS IN USE IN ALL PARTS OF THE WORLD

Write for Complete Details.
D. W. ONAN & SONS
 1467 Royalston Avenue - MINNEAPOLIS, MINN.




OIL for lubricating rubber bearings is just as welcome as smallpox. One of the best mixtures seems to be one part each of alcohol and glycerin. The alcohol evaporates and thus leaves a thin film of glycerin.

The prevailing practice in drilling high-speed steels, based on the use of modern equipment, is to use a 135-deg. point (not 118), a 7-deg. clearance, and a web thinned down to half its original thickness.

The modern double-ended end mill is the cheaper in the long run. Being a two-in-one tool, it has a low maintenance cost and a minimum lost-production cost.

A certain shop which requires several motor-generator units has solved a space problem by mounting the generator on top of the motor and using a multiple V-belt drive.

When punches are needed in press work, it is often economical to counterbore deeper so as to insert a washerlike pad under each punch head. If the punches ever get too short, simply remove the pads.

A plain milling cutter is not intended to cut from the extreme ends; however, it can be given side-cutting effects for a limited depth by grinding a 5-deg. relief on the ends of all the teeth.

It doesn't seem possible that 96 percent copper and only 2 percent iron and 2 percent cobalt will produce a metal that hardens like low-carbon steel. Such a metal, however, is now being made.

Thanks to punch-press safety devices, fewer fingers are being injured, but it would still be a good idea if the ram could drop only when two buttons, located about 18" apart, were pushed simultaneously.

The cost of mandrels to be used in connection with holes of precisely standard sizes can be reduced by making the tools double-end to serve two different dimensions. That is, of course, in cases where the width of the part is not over twice the internal diameter.

Please mention POPULAR SCIENCE when writing to advertisers.

COMING TO YOUR LOCAL THEATRE

the signal corps takes wing



What happens to army communications when bombs and shells wreck wires and wireless? The answer is pigeons... simple, ordinary pigeons who carry the commands of battle when all else fails. **POPULAR SCIENCE ON-THE-SCREEN** shows how the U.S. Army trains these winged messengers to the discipline of the old soldier. Don't miss it at your theatre.

clothes that can get near the water

There's no need to hang your clothes on a hickory limb now. For with an amazing new process (developed by Dupont) materials can be treated so that water rolls off as it does the proverbial duck's back. You'll enjoy seeing and hearing about it in the latest **POPULAR SCIENCE ON-THE-SCREEN**.



Prof. Oakes "De-Burps"

The Radish Does the stored-up energy of the gentle radish disturb you? If so, don't miss Prof. Oakes' latest side-splitting contribution to science, and your personal comfort.

popular science on-the-screen

POPULAR SCIENCE MONTHLY
353 Fourth Avenue, New York, N. Y.

☐ Here's my vote to bring the latest **POPULAR SCIENCE ON-THE-SCREEN** to my local theatre.

Theatre _____

Address _____

Produced in Cinecolor by Fairbanks & Carlisle with the cooperation of the Editors of **POPULAR SCIENCE MONTHLY**.
Distributed by Paramount Pictures.

Ask the manager of your local theatre when **POPULAR SCIENCE ON-THE-SCREEN** is coming. If it isn't scheduled, **MAIL THIS COUPON TODAY.**

A bargain in FILTERS



ONLY THE FINEST
dyed-in-the-mass

optical glass is used in Lafayette Filters. The filters are ground to insure faces absolutely flat and parallel. Colors are spectroscopically accurate. Here's great value! Use coupon to order.

COLOR	25 MM.	32 MM.	39 MM.
Light Yellow	84¢ each	98¢ each	\$1.19 each
Medium Yellow			
Light Green			
Medium Green			
Red			
Orange			

FREE Filter Manual with purchase of 2 or more filters.
FIFTY PAGES of values await the photographer in
Lafayette's new Camera Catalog No. 81. Mail the
coupon at once for your copy. It's FREE!

Lafayette Camera

NEW YORK • CHICAGO
ATLANTA • BOSTON
NEWARK • BRONX
JAMAICA, L. I.

LAFAYETTE CAMERA

DEPT. 9JC—100 SIXTH AVE., NEW YORK, N. Y.

☐ I Enclose \$..... Please Rush my order.

☐ Rush FREE Camera Catalog No. 81.

NAME.....

ADDRESS.....

CITY..... STATE.....

16MM. WRITE BASS CAMERA CO.
RCA Sound Motion Picture Projector
Sensational value... silent or sound... 750 watt lamp
— 10 watt output — jack for records or mike... easily
portable—lifelike reproduction—brilliant F:1.65 lens—
all refinements — trade in allowance — free literature.
Write for New CINE Bargaingram... Dept. P. S.
179 W. MADISON ST., CHICAGO, ILL.

PHOTO ENLARGEMENTS
5¢
Is Photography your hobby? Do you want
a profitable easy business at home? Make
PHOTO ENLARGEMENTS for yourself
and others. Your cost 5¢ each and less. The Ideal
Photo Enlarger is **AUTOMATIC**. No experience
required. Also **COPIES** any picture. **\$5.94**
COMPLETE. Interesting circular **FREE**.
IDEAL-X, 148 West 23 St., New York **ANY SIZE**

PHOTO ENLARGING
OFFERS BIG STEADY INCOME!
Make money daily with our photo enlarger. Takes
negatives up to 2½x2½" and makes quality prints
up to 8x10. Costs you 5¢ or less per enlargement.
Complete with lens, easel paper holder, self mask-
ing negative holder, masking type easel and de-
tailed instructions. Only \$4.85 Postpaid.
DE LUXE PHOTO COMPANY, Springfield, Ill.

New ELECTRIC SANDER...Many Uses
Portable GuldSander sands the
roughest surface and leaves it smooth
and clean. Saves time, energy and
money. Useful wherever sanding,
planing and finishing is done.
Removes paint and rust. Works on
many different materials. Runs on
either AC or DC. Popular price.
See your hardware dealer or write
direct for **FREE** folder on many uses.
SYRACUSE GUILD TOOL COMPANY
1740-98 N. Salina St., Syracuse, N. Y.

**Saves
TIME
and
TOIL**

Copper Wire Stiffens Lamp Gooseneck

FLEXIBLE goosenecks on photo lamp stands and other lamps often become worn and can no longer hold the weight of the reflector or shade in the desired position. Simply insert a length of No. 8 copper wire, either bare or insulated, into the neck. This will add to its stiffness.

In some cases, where the connecting wires pass through the neck, there may not be room for the addition of the stiffening wire. It will then be necessary to remove the lamp cord and carry it to the socket on the outside.
—ARTHUR TRAUFFER.



Inserting a copper wire to strengthen a limp gooseneck

Making Roll Film Slide Readily into a Reel



CREASE
LIGHTLY

THEN
UNFOLD

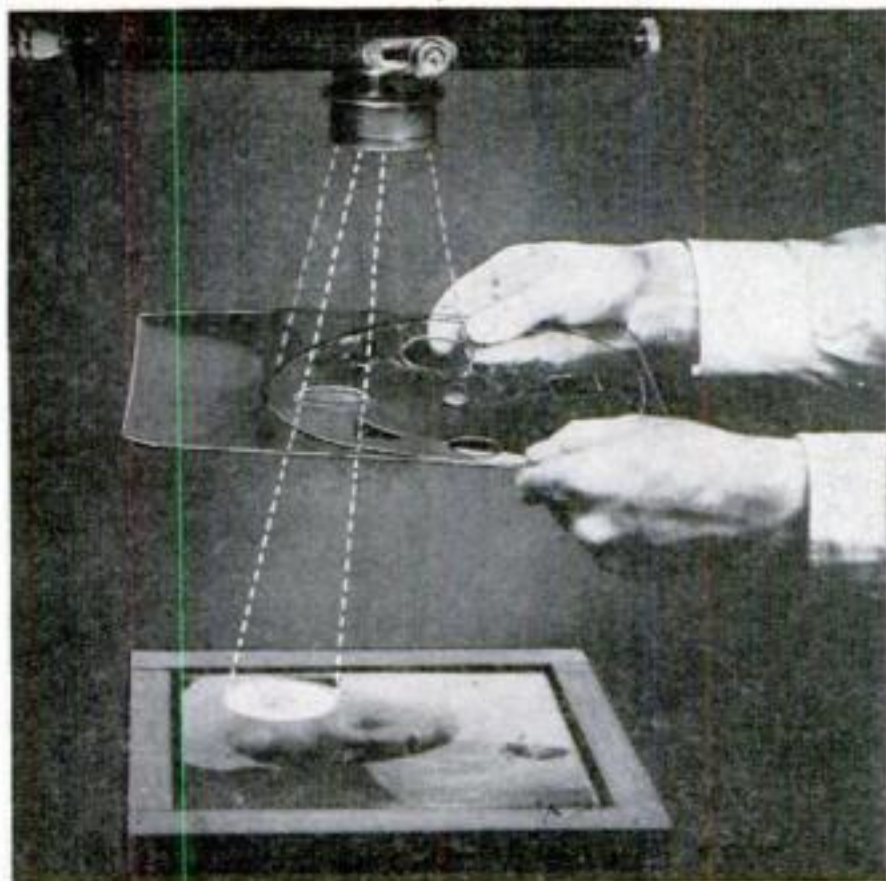
MANY exasperating moments are spent trying to load film in a roll-film tank reel. These can be avoided by a very simple operation. All you have to do is to crease the film lightly back on itself for about ½" as shown. Then unfold and thread on the

reel in the regular way. The crease offsets the natural tendency of the film to curl inward, which makes the film so difficult to push along. It also stiffens the film across its width, eliminating any tendency to buckle. The film will glide along the spiral groove almost as though rolling on ball bearings.—H. S. THOENEBE.

• • •

A STRING of ordinary Christmas-tree lights with all red bulbs can be strung along a large darkroom, not to serve instead of a safelight, but to provide a guide for walking about. Each bulb must be provided with a half shade to reflect the light away from the working area.—JOHN E. HELLAWELL.

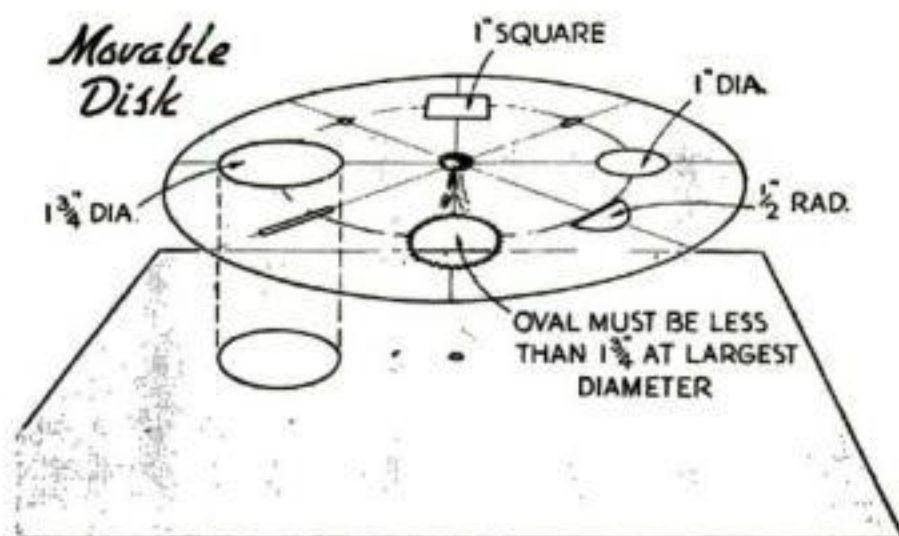
Please mention POPULAR SCIENCE when writing to advertisers.



Dodging Mask Provides Variety of Shapes

WITH its various openings, this dodging mask will be found helpful in photographic enlarging. It is made of two pieces of transparent celluloid (preferably red) or other cellulose material. Large discarded photographic film, if the emulsion is removed, will answer the purpose admirably. One piece is about 9" by 11", the other about 8" square. If clear stock is used, red cellulose wrapping tissue is attached to both pieces with rubber cement so the transmitted light will not affect the enlarging paper, which is not sensitive to red rays.

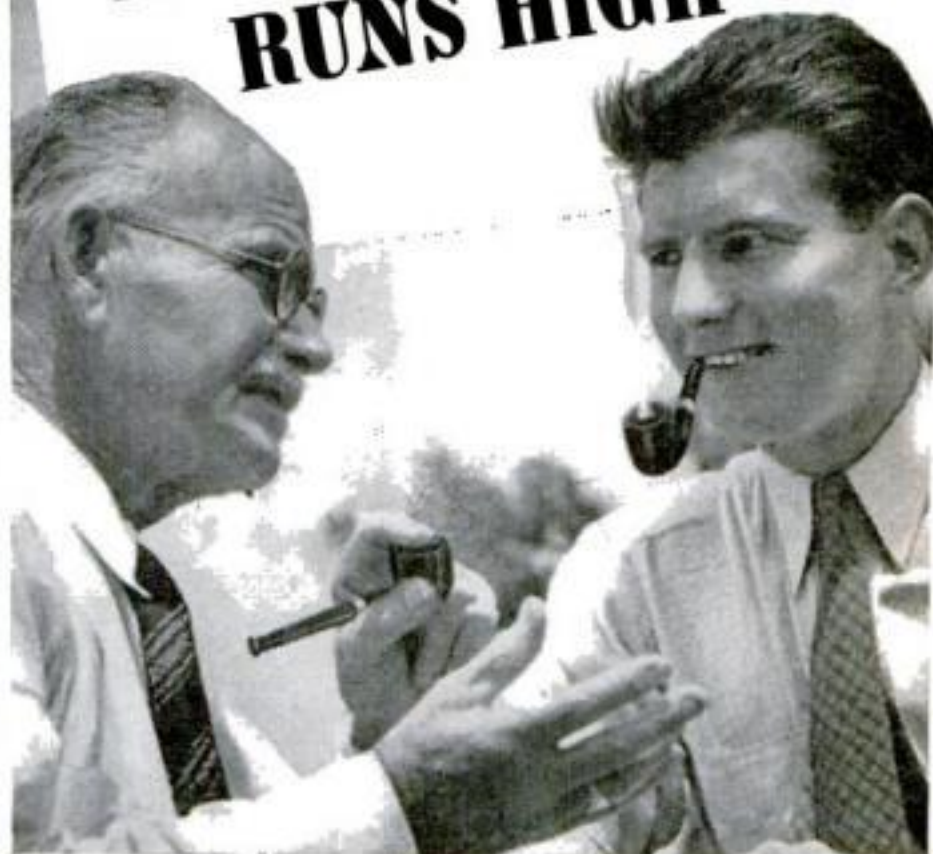
The 8" square piece is then cut into a circle, and openings are cut out with a razor blade as indicated. One large round opening is cut in the main mask. The two parts are assembled with a paper fastener so that any desired opening may be revolved into position over the circular opening in the rectangular mask.—FRANK CAPOREAL.



Transparent red or red-covered celluloid is used for cutting out the two parts of the dodging mask

Please mention POPULAR SCIENCE when writing to advertisers.

FEELIN' RUNS HIGH



About this truly different AROMATIC pipe tobacco

It's the plain truth . . . Bond Street is too out-of-the-ordinary for some smokers—that's just the argument. *But thousands of men won't ever again smoke anything else!*

Bond Street gives you *rare aromatic tobacco never before used in a popular price mixture*. Gives you "custom-blend" aroma, flavor and bite-free coolness . . . at popular price. Even the women approve your pipe . . . with Bond Street.

Get a 15¢ tin of Bond Street—find out which side you're on—do it today!

15¢



Today—try a tin of
BOND STREET
Pipe Tobacco

A Product of PHILIP MORRIS

TEST-O-LITE

Tests Everything Electrical

From 100 to 550 Volts APPLIANCES

A real necessity for electricians and home because it has 1001 uses. Equipped with a Neon light which tells instantly where trouble lies in electric circuits, fuses, cut-outs, motors, radios, all kinds of electric appliances, etc. Tells A.C. from D.C. Far superior to ordinary clumsy test bulb. Fountain pen size with clip for carrying in vest pocket. Lifetime guarantee.

\$1.50
At
Elec-
trical
Stores
or
Post-
paid



MOTORS

FUSES

PATENTED

L. S. BRACH MFG. CORP.
53 Dickerson St., Newark, N. J.

MEGOW

MODEL

World's largest manufacturer of Model Airplanes, Ships and Railroads. Send 5c postage for 100-page, profusely illustrated catalog.

- AIRPLANES
- SHIPS
- RAILROADS

MEGOW Dept. PS., Howard & Oxford Sts.
Phila., Pa. or 217 N. Desplains St., Chicago

ATKINS

Silver Steel
SAWS

FOR BETTER WORK &
MORE FUN DOING IT—

1. See Atkins Saws at your dealer
2. Send 10c for Valuable ATKINS "How to Do It" Book.

E. C. ATKINS AND COMPANY
428 S. Illinois St., Dept. S-9, Indianapolis, Ind.

BIG 7 FOOT GLIDER

Easily built, beautiful Class E
CLEVELAND CONDOR

Complete
Kit
only

\$1

- 48" Eaglet (Baby Bowler type) Soaring Glider, only 50c.
- Send 10c for latest catalog of Model Airplanes, Race Cars, RR's, Ships, etc.

CLEVELAND MODEL & SUPPLY CO., INC., 4508096 Lorain Ave., Cleveland, Ohio.

Orders under
\$1.50 add 15c
packing-post-
age charge.

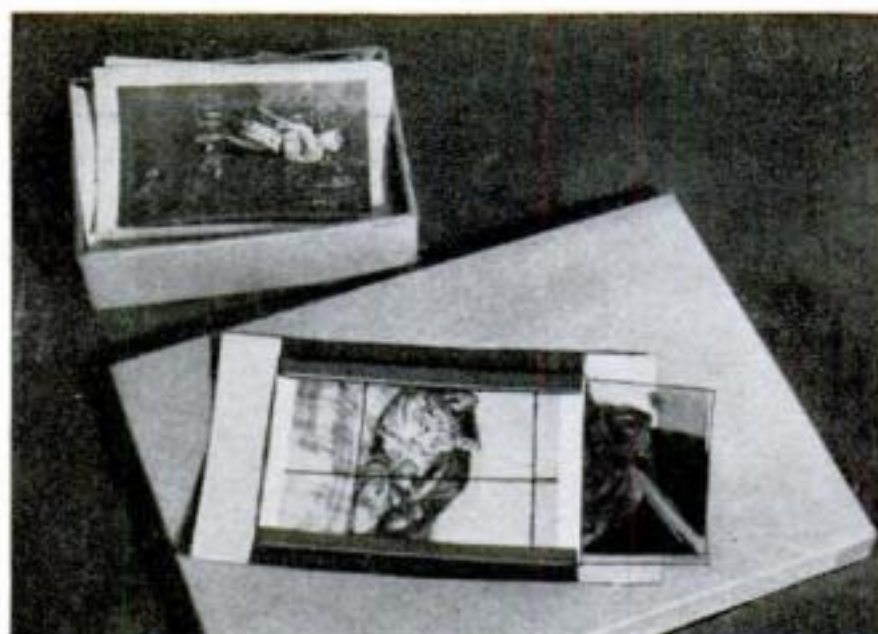
NOW a DYNAMIC HEAVY DUTY INDUSTRIAL WELDER

WORKS OFF 110-Volt Light
Socket. This marvelous
Dynamic Power Welder does the
work of much higher priced types. It is RETAIL
easily portable. WELDS Cylinder Blocks,
Bumpers, Fenders, Tanks, Farm Machinery,
etc. Will also solder and braze on the lightest
material. Works on iron, steel, tin, brass, cop-
per and all other metals. Men without previous
experience can make as much as \$5.00 on a one
hour repair job. In a year's time a Dynamic Welder
COSTS YOU LESS THAN 6 CENTS A DAY

Instructions Free—Open a welding shop now. AGENTS—Make big
profits selling to garages, factories, janitors and machine shops.
Write today for our 10-DAY TRIAL OFFER. DYNAMIC WELDER
COMPANY, 2226-NE SILVERTON ROAD, CHICAGO, ILLINOIS

BUILD YOUR GRANDFATHER CLOCK

SEND 25c for SIMPLE SHOP TESTED COPYRIGHTED BLUEPRINT
The Simple Sensible Red-I-Kut way as thousands have. DIME brings
PLANS and sixty picture "HOW" Book pricing many fine brass weight
Westminster, tube chime, electric and battery movements showing
nine beautiful colonial grandfather cases. Build now and save half.
KUEMPEL CHIME CLOCK CO., Bldg. A-24, Guttenberg, Iowa.



How to File Negatives with Photo Data Cards

AMATEUR photographers who are using the file-card system previously described in this department (P.S.M., Feb. '40, p. 168) can keep the negative of a photograph on the same card with the remainder of the data, provided the negative is smaller than the card. This is done by a slight change in the method of mounting the contact print on the back of the file card. Instead of being pasted on, it is fastened with strips of masking tape along two opposite edges. The negative is then slipped between the print and the card, where it remains as if in an envelope. This not only helps to centralize records, but saves considerable time in the darkroom.—THOMAS F. CONLON.

Tray Catches Developer Spilled from Tank

WHEN developing the largest size film a tank will accommodate, it is necessary to fill the tank as full as possible. Occasionally developer spills over the edge of the tank and is lost. If, however, the tank is set in a clean tray, the excess developer may be recovered.—W. W. LEVIN.



Field Trials for Dogs

(Continued from page 75)

the factors which control scenting conditions. He constructed huge metal funnels, containing delicate spider-web diaphragms. Sunk in the ground, they proved that the earth literally "breathes," air passing out of the ground when it is warmer than the surrounding atmosphere and into the ground when it is cooler than the air. Thus, scenting conditions are best when the earth is warmer than the air.

Near the spot where the Clinton course swings south along the stream, one of the pointers locates the first bird. It "freezes" instantly. The judges note its pointing style. Both head and tail should be held above the line of the back. Then its trainer moves in, raises a pistol, and fires a blank cartridge over the back of the pointing dog. Every animal entered in the meet must pass this test to prove it is not gun-shy.

As soon as they break out of the woods, the two pointers rush this way and that among the bushes and planted patches of grain. Each animal has its individual manner of covering an area. The "pattern" made by its zigzagging course is carefully noted by the two judges. If a dog bolts straight through an area or circles it without thorough investigation, it is penalized.

Spectators on the hillside watch the dogs intently. From the "let 'em go!" of the break-away to the "Take 'em up!" of the finish, a field trial is often a nip-and-tuck struggle, and the minutes in the meadow are among the most vital in the contest. Time after time, the dogs stiffen, scenting the pheasants which have just been released or others previously let loose. The judges have their watches out. The contest has narrowed down to seconds. Then, one of the pointers flushes a bird and breaks after it, chasing it half across the field in spite of the owner's frantic blasts on the whistle. That blunder gives the higher score to its more steady brace-mate.

A few minutes later, while these two pointers are being carefully rubbed down, another pair begins the circuit of the course. So the contest continues, hour after hour. There are exciting upsets; stirring exhibitions of training and skill. And, finally, at the green trailer which forms the temporary headquarters of the club, solid silver plates are awarded to the winners. These animals, the product of scientific breeding and training, have demonstrated the greatest degree of speed, scenting ability, and stamina—the three outstanding requisites of the field-trial champion.

SECRETARIES SURE COME SMART THESE DAYS



YOU'RE WRONG. The gal on his lap is not his secretary. It's his wife. She's admiring that smooth, fresh-feeling Barbasol

Face his secretary told him to get. No harsh irritants in modern Barbasol to dry, tighten, coarsen the skin. Only bland ingredients that soothe the skin as well as soften the beard. Try Barbasol and see what wonders it works with your face in ten short days or so.

YOU'RE RIGHT. He does have tender skin but shaves with Barbasol—with pleasure! Here's the secret! Barbasol is modern. Soothing, cooling cream that it is, Barbasol does the job of old-fashioned preparations without raising red with your skin. Quickest, cleanest, easiest, best-feeling shave you ever had. Try Barbasol and see. Three sizes: large tube, 25¢; giant tube, 50¢; family jar, 75¢. Five Barbasol Blades, 15¢.



For Modern Shaving

No Brush • No Lather • No Rub-in

The ONLY WORKSHOP TOOL OF ITS KIND—
PLANES and FINISHES
PANELS • RABBETS
ROUTS • TENONS



FITS ANY DRILL PRESS \$7.50 COMPLETE READY TO USE

• A precision safety tool . . . does five distinct operations . . . saves time, money, labor . . . planes and finishes to precision smoothness all woods, tricky grains and knots . . . provides intricate, beautiful paneling effects with ease and speed . . . rabbets, grooves and routs . . . fashions tenons with uncanny accuracy and lightning speed. No blade adjustments required for any or all operations. Fits any 1/4 h.p. or larger drill press.

MONEY BACK FREE TRIAL GUARANTEE. You risk nothing. Send check or money order for \$7.50 or order C.O.D. Postage prepaid. Use it for five days and get full refund if not satisfied.

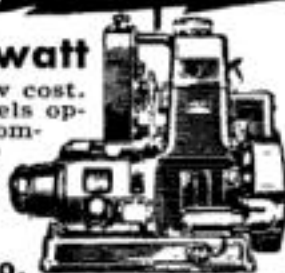
BARRON TOOL CO., INC., 316 ARCHITECTS BLDG., DETROIT, MICH.

THE BARRON MULTI-PURPOSE 5-IN-1 ROTARY WOOD PLANER

WITTE DIESELECTRIC PLANTS

POWER & LIGHT for 1¢ a Kilowatt

Make your own electricity at this amazingly low cost. Quality built, dependable, efficient WITTE Diesels operate on cheap, non-explosive fuel. Rugged, compact, easy to install, simple to operate. 1500 to 8000 Watts; vertical, horizontal. Easy to buy. Pay for themselves out of savings. WRITE now for literature and name of dealer.



WITTE ENGINE WORKS

2229 OAKLAND AVE. KANSAS CITY, MO.

FREE TRAILER PARTS CATALOG

We'll save you money on—axles, springs, wheels, couplers, windows, sinks, water pumps, brakes, refrigerators, beds, lamps, inside and out, 6V lamps, furniture, jacks—everything. Special discount to mfrs. **NATIONAL TRAILER EQUIPMENT CO.** Successors to Kar-A-Van Industries, Inc. Dept. S-5-714 W. Wisconsin Ave., Milwaukee, Wis.



Complete Plans and Building Instructions, 10¢

Choose from World's Largest Line of Power Tools!
FREE New 1940 Catalog covers Metal and Woodworking Tools, accessories, motors for every purse. Write Walker-Turner Co., Inc., 290 South Ave., Plainfield, N. J.

DRIVER Engineered POWER TOOLS

NEW BENJAMIN AIR RIFLES WITH HAND PUMP MADE IN U.S.A.



ACCURATE SHOOTING WITH CHAMBERED AIR

You can use new model BENJAMIN AIR RIFLES WITH LEVER HAND PUMP anywhere, for practice firing or just plinking, around the house or camping, fishing, hunting, etc., at lowest cost. Shooting force is adjustable with amazing maximum power and accuracy—no recoil or forward lunge to disturb your aim. Bolt Action-Hammer Fire-Hair Trigger-Safety Lock-Hand Pump. Single Shot BB \$7.50; Single Shot Cal. 177 or .22 with rifled barrel \$8.50; BB 25 Shot \$9.00. Also a complete line of BENJAMIN GENUINE COMPRESSED AIR PISTOLS from dealer or factory. Write Today. BENJAMIN AIR RIFLE CO., 893 MARION ST., ST. LOUIS, MO., U.S.A.

STOP SEND to Bass - for this **DOUBLE 8 REVERE**

Only 29.50


Light weight — automatic film loop — 5 speeds — 5 ft. spring motor — speed control — 12.5 mm. Wollensak Universal focus F:3.5 lens — Turret model . . . \$65.00 — 500 Watt Revere Projector . . . \$59.00 — write Dept. PS.

Bass CAMERA Co. CHICAGO, ILL. 179 W. MADISON ST.

GERSTNER Tool Chests

Distinctive Designs, Refined Finishes, Superior Construction. Preferred by Machinists and Toolmakers everywhere. Free Catalog.

GERSTNER TOOL CHESTS 540 Columbia St. Dayton, Ohio



FREE CHEMISTRY BOOK

Big valuable laboratory catalog easily worth 25¢—FREE—listing thousands of C. P. chemicals, apparatus, microscopes, scientific books, biological and laboratory supplies. Items as low as 5¢. Equipment for complete industrial, professional and home laboratories at bargain prices. Save money! Just write post card—for a short time only there will be no mailing charge. Get your copy of handbook NOW!

KEMKIT SCIENTIFIC CORP.

397A Bridge St.

Brooklyn, New York

Can We Defend Our Coasts?

(Continued from page 97)

their anchors and control wires stored, and the mines laid at the outbreak of war. Contact mines are used to block off the parts of harbor entrances which need not be used by friendly ships. Controlled mines are used to guard entrances which must be used by friendly shipping and which are within range of the harbor-defense guns and searchlights which protect the fields against sweeping. The electrical control apparatus may be set so that a mine will explode the instant that a ship comes in contact with it, or so that the mine will signal that it has been struck and then will explode after any desired number of seconds—a method which makes it fairly certain that the mine will explode while it is in contact with the bottom of the ship. Until its firing switch is closed, a controlled mine is harmless.

During the peaceful years that followed the end of the World War the Coast Artillery, like the rest of the Army, suffered from the starvation diet imposed on it by inadequate appropriations. Our coast-defense system, which had been one of the world's best, was allowed to go downhill. In 1936 increased appropriations made it possible for the Coast Artillery to start improving our Panama Canal and Hawaiian defenses. Our Pacific Coast harbor defenses also were improved. But until about a year ago our Atlantic and Pacific seacoast defenses were in a decidedly unsatisfactory condition. Since then steady progress has been made in improving them. Some fortifications have been modernized, an undisclosed number of new guns have been mounted, and the defenses against attack from the air have been tremendously increased. But we haven't gone nearly far enough. We need more guns, and we need more highly trained coast artillerymen to handle them.

Harbor defenses can't be improvised in an emergency. It takes close to three years to build a battery of heavy guns. Strong harbor defenses aren't likely to be attacked from the sea because the loss in irreplaceable ships would be too heavy. Weak harbor defenses guarding important ports and cities are an almost irresistible temptation to an enemy fleet, especially at the beginning of a war. Even if our coast defenses never have to fire a shot, their cost will be a very low-priced insurance premium for the protection they give.

Flyers by the Ten Thousand

(Continued from page 49)

legians. Only one scholarship winner in each course may be a woman. Those who accept scholarships must pay an additional fee of twenty dollars to cover the cost of physical examination and required insurance.

About 7,000 students started the ground courses early in January of this year, and over 700 winners of C.A.A. and privately offered scholarships, together with non-winners who are paying their own flight-instruction costs of about \$300, now are receiving flying instruction. It is expected that by the end of August nearly all of them will have completed their courses and received licenses.

Women college students showed as keen interest as the men did when the courses were announced last year. Forty students in four women's colleges were accepted, and 324 girls in coeducational institutions. A large proportion of them made the grade, although the percentage of those who failed to win licenses was almost twice as large as that of men. Ground-course instructors told me that the girls usually had to work harder than the men because they weren't so strong in mathematics. One flying teacher said that although all four of the girls in his classes got through all right, they were considerably more nervous than men, and a little slower to learn.

The ground course, which consists of seventy-two one-hour lectures, instructs the students thoroughly in the history of aviation, flight theory, the C.A.A. regulations, air navigation, meteorology, the use of parachutes, the aircraft power plant, instruments, and radio. To go on to the flight course the student must pass an examination with a minimum mark of seventy in each subject.

The flying course is given by a C.A.A.-approved operator, who must provide one instructor and one instruction plane for each fifteen students, at an airport convenient to the college. It is divided into three stages—a minimum of eight hours of dual instruction; a minimum of three hours of preliminary solo flying with one hour of check flight; and a minimum of fifteen hours of advanced solo work with eight hours of dual instruction as a check.

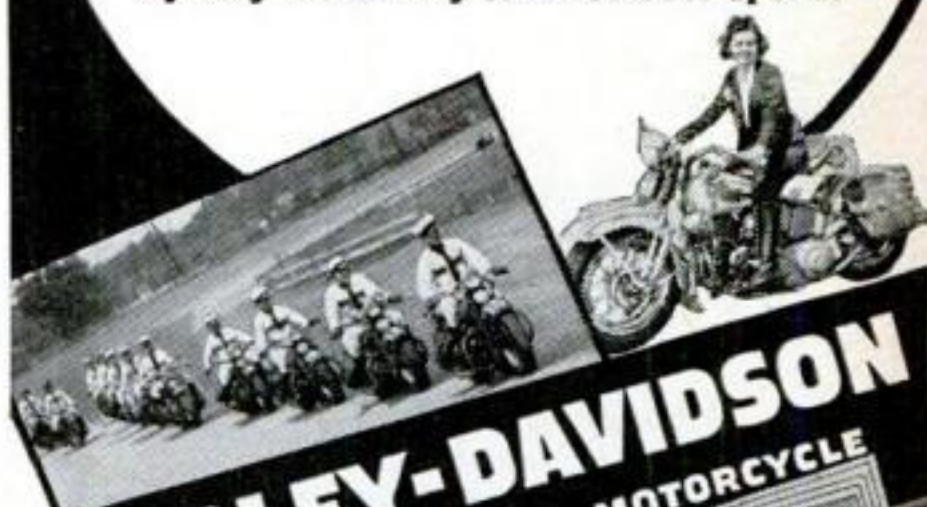
C.A.A. instructors devote the first flying lessons, which are given on the ground, to making the students feel at home in the plane and to simple explanations of the controls and instruments. All instructors agree that nervous and muscular tension is the

(Continued on page 220)

TRAVEL! THRILLS! ADVENTURE!

on a **HARLEY-DAVIDSON**

Pack your vacation with action — good times—excitement! Explore distant places — see new sights—visit pleasure spots—all at little cost! Pal with fun-loving riders on club runs and gypsy tours. Take in rallies, hillclimbs, race meets and other thrilling events! See your Harley-Davidson dealer — learn why motorcycling is the king of all outdoor sports!



HARLEY-DAVIDSON

WORLD'S CHAMPION MOTORCYCLE

Free

Send Coupon NOW

HARLEY-DAVIDSON MOTOR CO.

Dept. PS, Milwaukee, Wis.

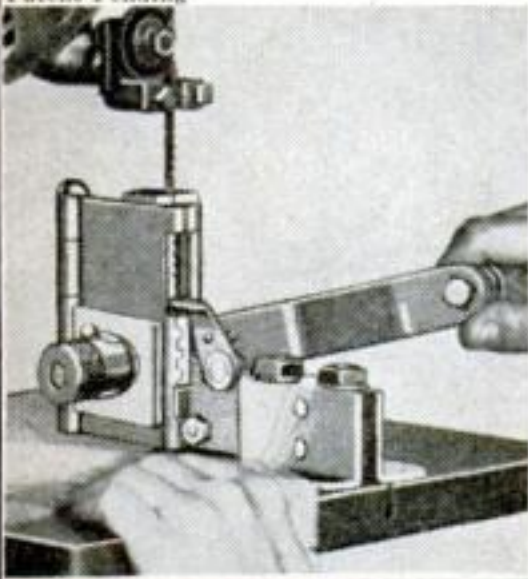
Send FREE copy of big 24-page "Enthusiast" magazine filled with thrilling motorcycle pictures and stories. Also literature on the new Harley-Davidsons. Stamp is enclosed for mailing cost.

Name

Address

New!!! K-B BAND SAW RESET

Patent Pending



Resets your bandsaw blades accurately in your own shop in a few minutes without removing blade from machine. Precision results guaranteed! One trial and you're convinced. Saves time and prolongs life of blade.

Sets 5, 6, or 7 pitch blades from 3/16" to 5/8" in width. Specify pitch of blade when ordering.

5 DAY TRIAL

Price \$12.50 C.O.D.—Prepaid cash with order.

K-B DEVICES COMPANY
Geneseo—PS1—Illinois



Chemical Catalog FREE 40 Big Bargain Pages

Of Laboratory Supplies, Apparatus, Chemicals, Scientific Books, Telescopes, Microscopes, Biological Needs. Save Money! Buy direct. Send Now. It's FREE. Full of Bargains & valuable information.

J. H. WINN MFG. CO., Dept. 109, 124 W. 23 St., N.Y.

BUILD ARC WELDER FROM OLD GENERATOR

For Light or Heavy Work. 75-200 amperes. Complete PLANS and valuable catalog 35c. Over 900 Electrical Supply Bargains.

LeJay Mfg. Co., 1323 LeJay Building, Minneapolis, Minnesota



BIG MONEY Assembling NEW BOAT!

Make big money on each 20-lb. Mead KI-YAK you easily assemble at home from complete "cut-to-fit" Kit at amazing LOW COST! Seaworthy, Fast! Supplied thing afloat. (Complete Sailing Rig, a few dollars extra.) Also 2 other portable paddle-sail models AND 2 portable outboard motor, sail, oars models. Finished Double Blade Paddle or Oars now INCLUDED with your KI-YAK. Write for Free Circulars, Factory-to-you-prices!

WRITE
for big
illustrated
FREE
circulars!

MEAD GLIDERS, 15 S. Market, Dept. D-90, CHICAGO, ILL.

Eliminate Ford Brake Troubles

Your Ford car is listed in the so-called lower price class but has more brake lining area and larger drums than the others; in fact, as much or more brake area than all but the higher priced cars. You can have safe, sure, unfailing mechanical brakes! Install easily yourself our **SIMPLEX FLOATING WEDGES** to center the shoes for mechanical assurance with hydraulic performance. A set of four, one for each wheel, all for \$1.75. All models 1928-38. Send for circular.



SIMPLEX WEDGE EXCHANGE

Dept. P.S.-9, 615 Jefferson Street

Ottawa, Illinois

HANDEE

Tool of 1001 Uses

A WHOLE TOOL SHOP IN YOUR HAND

Smooth, steady power at your fingertips. Uses 300 accessories to grind, drill, polish, rout, cut, carve, sand, saw, sharpen, engrave, etc. Plugs in any AC or DC socket.

10 Days' Money-Back Trial

Order today. Standard Model (illustrated) 18,000 r.p.m. 16 oz. \$10.75 postpaid with 3 Accessories . . . DeLuxe Model 25,000 r.p.m. 12 oz. \$18.50 postpaid with 6 Accessories.

Chicago Wheel & Mfg. Co., 115 S. Aberdeen St., Chicago, Ill.



Save
Hours
of Hand
Work

FREE 64-PAGE CATALOG

Complete information on Handee Products and their wide application in crafts work and industry all over the world.

Flyers by the Ten Thousand

(Continued from page 219)

most deadly enemy of good flying. They are alert for indications that the student is "choking the stick"—getting a drowning man's clutch on the control. This prevents the development of the delicate "feel" by which good pilots fly.

During early dual flights the instructor, in the front seat, demonstrates simple maneuvers and the student follows his movements on the dual controls. Then the student is allowed to fly the plane except when taking off and landing, with the instructor ready to take over if he makes a serious mistake. In the later lessons of the dual-instruction stage the instructor demonstrates spins and simulated forced landings, and the student is permitted to make into-wind take-offs, and into-wind landings without power.

As soon after the minimum eight hours of dual instruction as the teacher thinks he is competent, the student makes his first solo flight. He devotes at least six half-hour periods, with as much dual check instruction as his instructor thinks desirable, to practicing level flight, turns, glides, and other elementary maneuvers. Then he goes on to advanced solo flight and devotes fifteen hours in the air, checked by eight hours of dual instruction, to precision landings, stalls and spins, power turns, cross-wind take-offs and landings with power, and other advanced maneuvers, leading up to a fifty-mile cross-country solo flight over a triangular course, and finally to the examination for his private-pilot license.

The Civil Aeronautics Authority's pilot-training program has been sensationally successful in training a large number of pilots with a hitherto unknown degree of safety. It is expected that during this coming year at least 600 colleges will offer C.A.A. courses to their undergraduates, and that there will be a proportionate increase in the number of noncollege courses. Many of this spring's graduates intend to enter Army or Navy flying schools after they have completed their advanced courses this summer.

Already the program has helped materially to increase the number of licensed pilots in the United States from 33,000 to 45,000 in less than a year. Aviation experts are confident that the expanded program will provide a large number of well-grounded candidates for commissions in our naval and military air services, and that many of its graduates will become pilots of the new fighting planes on which some day the safety of America may depend.

Is It Murder?

(Continued from page 71)

with pen, pencil, nor typewriter. It was the impression left on a sheet of tablet paper when, according to the husband, the original had been produced on the woman's death-bed. He declared he had never been able to find the will itself, but had discovered the tablet with the impression writing on it after his wife's death. John F. Tyrrell, noted Milwaukee authority on questioned documents, was called in to examine the ghost writing. His ingenuity in proving it could not have been produced by the dying woman stands as a classic example of the resourcefulness of the modern scientific sleuth.

Examining the tablet closely, Tyrrell found that the impression was faintly visible down to the fifth sheet. Yet, when he studied the ordinary handwriting of the dead woman, he noted that she used an extremely light touch. The night before his appearance in court, Tyrrell set to work with a piece of wire, a tin funnel, and a pencil. First, he mounted the pencil, point downward, in the bottom of the funnel. Then, he made a loop in one end of the wire and slipped the funnel into it. With this simple apparatus and a bag of lead shot he appeared in court the next day.

Pouring shot into the funnel, a little at a time, he pulled the weighted pencil along the tablet with a piece of string, at the same time using the wire loop to keep the funnel upright without removing any of the load from the pencil point. Three ounces of shot proved sufficient to produce a line comparable to that found in the known writing of the dead woman. But *three additional pounds* had to be poured into the funnel before the pressure was great enough to carry the impression down to the fifth sheet of the tablet. In other words, the phantom document supposedly written by the dying woman would have required sixteen times more pressure than she used in normal writing when in full possession of her health and strength.

The absurdity of that story was graphically disclosed by Tyrrell's simple demonstration. Convicted of forging the note and of poisoning his wife, the husband died in the penitentiary. Like scores of other "perfect-crime" killers who have sought to pass off murders as suicides, he overlooked one thing—the skill and resourcefulness of the science-using detective employing all the new discoveries of the laboratory as weapons against the arch criminal, the cold-blooded murderer who plots in advance to escape the consequences of his crime.

**FALSE ALARM! IT'S
JUST A MOTORIST
WHO HASN'T HEARD
ABOUT SANI-FLUSH!**



TRUE, Sani-Flush was made originally to clean toilet bowls. And today you'll find it in almost every bathroom. Sani-Flush is also the best way many motorists have found to keep a radiator free of rust, scale and sludge.

It only costs 10c to clean out a car radiator with Sani-Flush (25c for the largest truck or tractor). You can do it yourself in a few minutes (*directions on the can*). If you prefer, have the job done at the service station—insist on Sani-Flush. It cannot injure motor or fittings. Sold by grocery, drug, hardware, and 5-and-10c stores. 10c and 25c sizes. The Hygienic Products Company, Canton, Ohio.

Sani-Flush
CLEANS OUT RADIATORS



DIRT WON'T STICK

to hands covered with the greaseless cream called Du Pont **PRO-TEK**. It acts like an invisible glove—prevents grime and paint adhering to the skin. To remove, just wash the hands in running water. This dissolves the protective film, and carries away the dirt with it. Write DU PONT, Wilmington, Delaware.



BUILD A BOAT BY THE WELCH SYSTEM. It's inexpensive; interesting and profitable. Everything for building, equipping or repairing boats. USE WELCH READY CUT PARTS. Send 10c for catalog showing boats of many types; boat hardware; propellers; Marine paints; Sails; Boat finishing Materials and WELCH WHITE CAP MARINE MOTORS. **WELCH BOAT CO., STATION K-9, MILWAUKEE, WISCONSIN**

AMAZING NEW ELECTRIC ARC WELDER

RETAILS
ONLY
\$2.95
COMPLETE

FULLY
GUARANTEED



Plugs Into
Light Socket

Amazing new HANDI-WELD Electric Arc Welder—operates from 110 volt, A.C. or D.C., same as other arc welders higher priced—generates tremendous heat to weld all kinds of metal. Not a toy welder that uses carbons, but actually uses standard coated rods—sizes 1/16" and 3/32". Generous supply furnished with welder. Guaranteed not to burn out. Repairs fenders, auto bodies, radiators, pre-heated small castings and machinery parts. Take HANDI-WELD anywhere to job, operate from light socket. Sturdily built of finest materials to last years. Fully guaranteed by Big Manufacturer.

SEND NO MONEY—You'll find a thousand uses for the HANDI-WELD around your home, garage, work shop. Also by garages, factories, repair shops, farmers, inventors, tin shops, plumbers, etc. Order HANDI-WELD now. Send no money. We'll rush one to you, complete with rods and goggles. Pay postman only \$2.95 plus few cents postage. If not delighted, return HANDI-WELD in 5 days from receipt and money paid for it will be refunded instantly. Rush your order now.

KUMFY PRODUCTS, INC. Dept. H-205 Cincinnati, O.

SAVE MONEY build your own SMITH COMPRESSOR



We will furnish complete instructions with a **Smith Compressor Head and Accessories**

With a Ford Motor and shop facilities you can easily assemble a Smith Air Compressor. You'll have a smooth-performing, efficient compressor with 60 cu. ft. a minute capacity—all the power you need to operate rock drills and paving breakers. Pressure up to 175 lbs. a square inch. Head equipped with high speed compressor valves; automatic unloading and idling.

GORDON SMITH & CO. Inc.
405 College Street
Bowling Green, Ky.

write today

OWN A Printing Business

Cards, Tickets, Stationery, etc. Good profit in spare time. **PRINT YOUR OWN** greeting cards, movie titles, church work, etc. Save money. Easy rules supplied. **Junior Press \$8, Senior Outfits \$16 up.** Have home shop. Raised printing like engraving too. Sold direct from factory only. Write for free catalog and all details. **KELSEY, INC. X-33, MERIDEN, CONN.**



SENSATIONAL Flexible SHAFT TOOL

The **FOREDOM FLEXIBLE SHAFT TOOL** brings new skill, new ease for home and master craftsmen. Uses over 200 accessories. Grinds, polishes, drills, mills, engraves, sharpens, slots, sands, curves, etc., etc. Every hobbyist should own one. Send for free illustrated catalog. **FOREDOM ELECTRIC CO., Dept. 157, 27 Park Pl., New York, N.Y.**



BUILD YOURSELF A MIDGET CAR

WE SPECIALIZE IN WHEEL SETS, ENGINES, ETC. for building Cars, Scooters, Trucks, etc. We carry only the best at the lowest prices. Send 10c for parts catalog and plans for three Midget Racers, Scooters & other vehicles. It pays to use only reliable plans and parts—We guarantee satisfaction. **Build-Your-Own Devices, 536 North Parkside, Dept. PS-9, Chicago**

BUILD AN OUTSIDE FIREPLACE

Ask today for your set of 8 complete plans. Easy and inexpensive to follow. Fun for the whole family to build and use. Enclose 10c for handling. **The MAJESTIC Co. 749 ERIE STREET HUNTINGTON, INDIANA**



Woodworkers: Here it is!

only
10c

Harold Hunt's 1940 catalog! Latest, **UP-TO-DATE IDEAS** for experts and amateurs; **SPECIAL BARGAINS** in rare woods, machines, and all kinds of supplies. Get posted! Send only **10c** to **CRAFTSMAN'S WOOD SERVICE CO. 2729 S. Mary Street Div. 3396, CHICAGO**

Grooming the Iron Cavalry

(Continued from page 101)

as the iron cavalry, artillery must be motorized. The battalion attached to the brigade carries its gun crews in half-track personnel carriers of the same type as is used by the machine-gun troops, and tows its 75-millimeter howitzers behind them. These howitzers have a range of five and a half miles—only about two thirds of the range of the 75-millimeter guns which they have replaced for cavalry use, but their high-angle, lobbing type of fire and quick-aiming characteristics make them decidedly useful to the Mechanized Brigade.

Accompanying the fighting vehicles is the train—big motor trucks loaded with drums of gasoline, ammunition, and food; trucks which are fast-moving machine shops; mobile kitchens which cook as they roll. When the full brigade is marching on a single road its column stretches twenty miles from head to tail.

Ahead of and above the dust-streaked gray-green combat vehicles and trucks fly the planes of the observation squadron. In war their most important mission would be to obtain and report information about the enemy. On peacetime marches their main job is to watch the long column for gaps, and to report them by radio. The commander of the iron cavalry, Brig. Gen. Adna R. Chaffee—he is one of the Army's most brilliant cavalry officers and in his younger days was one of its top competitive riders—often controls the march from the air.

In an all-motorized, all-mechanized force equipped with close to 600 vehicles, many of them of exceptionally complicated character, maintenance becomes a major problem.

When the brigade is on the move, each troop is followed by its maintenance truck, whose crew makes any roadside repairs it can handle. Regimental maintenance trucks follow each regiment, and their crews take care of more serious breakdowns. At the tail of the column roll the trucks of the ordnance maintenance company—trucks loaded with spare parts and even spare engines, machine-shop trucks, a generator truck which provides electric lights for the field machine shop which is set up each evening in a big, square tent. Wreckers tow disabled vehicles to the night's bivouac, and the rule is that the cripples must be ready to roll when the brigade marches in the morning. On a march last year the maintenance companies handled eleven major repair jobs in one night, putting in 263 man labor hours doing it. At the end of the 700-mile trek the brigade had all but two of its combat cars

Please mention POPULAR SCIENCE when writing to advertisers.

This One



BFDZ-KZT-DSNP

and all its other vehicles except one half-track in condition to take part in a strenuous tactical exercise.

Thirty-five miles is a full day's march for horse cavalry. Fifty miles is a forced march. Returning from a Civil War raid into Pennsylvania, Jeb Stuart's Confederate troopers won lasting fame by riding from Chambersburg to White's Ford on the Potomac, eighty-four miles, in twenty-four hours—one of the great cavalry marches of history.

A hundred and fifty miles is a normal day's march for the Mechanized Brigade. Marching from Fort Knox to Plattsburg last summer, it did 1,000 miles in six days. On one occasion it marched 330 miles in a little over twenty-four hours. These marches weren't made under war conditions, of course, but the iron cavalry moves fast—and it can hit hard when it gets there.

The younger soldiers of the Mechanized Brigade have served only in the iron cavalry. They were attracted to it through their interest in automobile mechanics and by the fact that it is something brand new. The brigade has no difficulty in filling its ranks with high-grade recruits.

Nearly all the officers and many of the noncommissioned officers are former horse cavalymen. Some of them I talked with admitted that they missed the horses, but all of them were keenly interested in their new jobs. An old top sergeant, with a lot of service stripes on his sleeve, said: "When you first come to the Mechanized Brigade from a horse regiment, everything seems strange to you. And then you begin to realize that, after all, the Mechanized Brigade isn't so very different from any other cavalry outfit—that you're really doing the same things for the same reasons, only you're doing them in new ways. Cavalry is cavalry, whether you're riding a horse or driving a hell buggy."

POPULAR SCIENCE Question Bee

THESE are the correct answers to the Question Bee on page 116. Give yourself five points for each one you had right. A total score of 75 to 85 is good; 90 or better is excellent.

- | | | | |
|------|---------|-----------|---------------|
| 1. d | 6. No | 11. Mole | 16. Fauna |
| 2. c | 7. No | 12. Plane | 17. Tackle |
| 3. a | 8. Yes | 13. Jack | 18. Longitude |
| 4. b | 9. No | 14. Root | 19. Strain |
| 5. c | 10. Yes | 15. Tap | 20. Bit |



ALLIED'S NEW 1941 RADIO AND PARTS CATALOG

212 PAGES JUST OUT!

FREE

EVERYTHING IN RADIO AT LOWEST PRICES!





65 NEW RADIOS

The 1941 RADIO HITS you've been waiting for! Knockout values—new Plastic models, world-wide sets—new "Camera" and 3-way Portables; 1941 low-cost Phono-Radio-Recorders, Combinations, Auto Sets, Amateur receivers—48 pages of models for every purpose at new low prices!



SOUND SYSTEMS

Sensational 1941 Public Address Systems—for every P. A. application. 7 to 75 watts—new features, new ideas, new low prices. Time Payment Plan—15 Day Trial Offer. Complete listings of mikes, speakers, phono equipment, recorders, etc.—all in a big special 35-page P. A. section.

MORE THAN 15,000 RADIO ITEMS! BIG MONEY-SAVING BARGAIN SECTION!



Learn Radio

BUILD WITH ALLIED KITS

Build your own radio set, transmitter or radio device—learn while you build! Dozens of new, low-cost easy-to-build kits; new diagrams—more than 15,000 quality parts. Free matched parts lists for building any circuit. Learn Radio quickly, easily with ALLIED's help.



Allied's RADIO BUILDERS HANDBOOK

Send for this RADIO BUILDERS' HANDBOOK—a valuable beginner's book on radio; tells how to select circuits, read diagrams, build sets, etc. Easy to understand; well-illustrated; helpful. Order by coupon below. **10c** Only.....

ALLIED RADIO

833 W. Jackson Blvd., Dept. 7-J-1
Chicago, Illinois

☐ RUSH me your FREE 1941 Fall Radio Catalog.

☐ ENCLOSED find 10c. Send me the "Radio Builders' Handbook."

Name.....

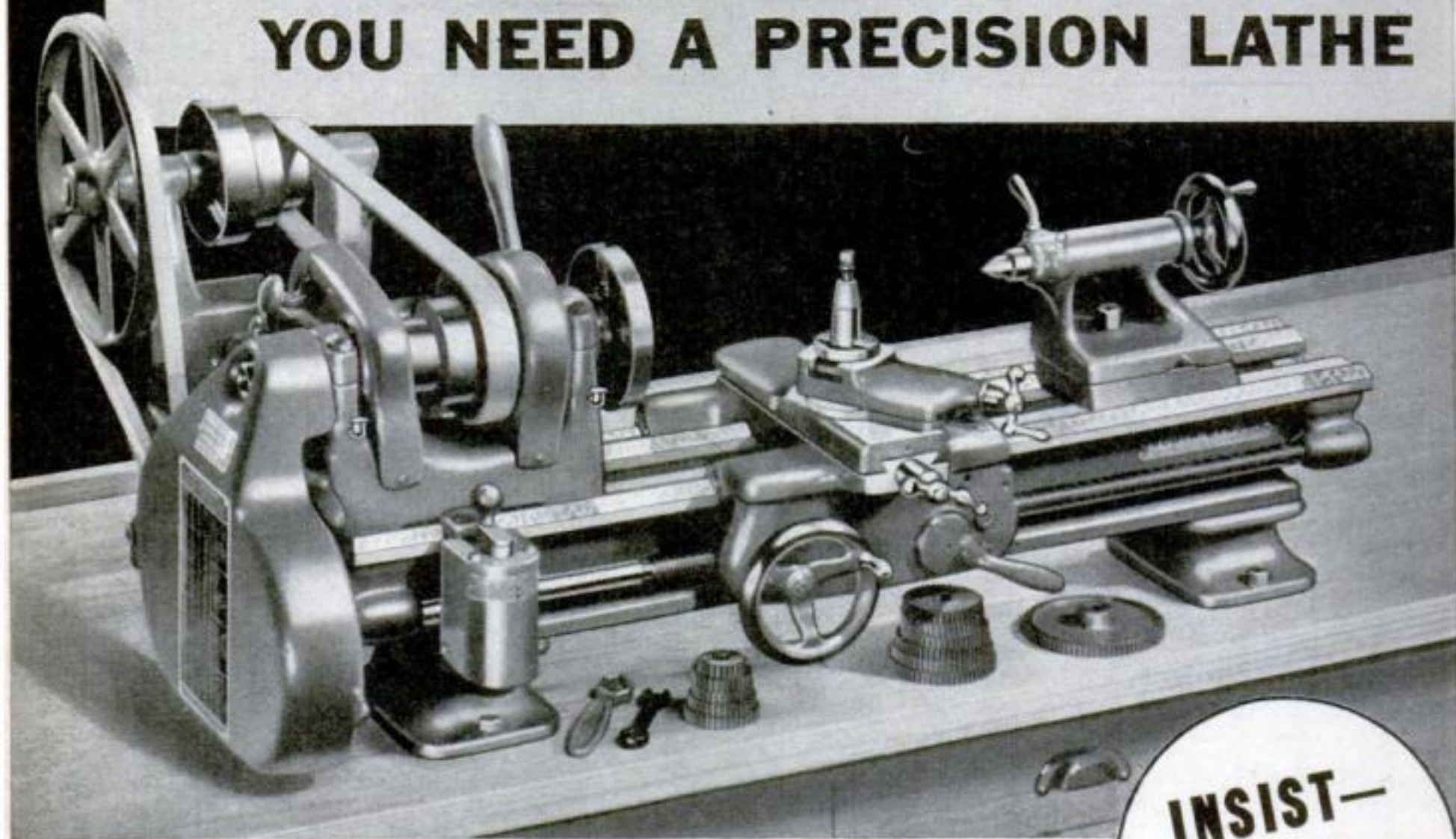
Address.....

City..... State.....

CATALOG FREE

Send this Coupon!

FOR ACCURATE WORK YOU NEED A PRECISION LATHE



No. 415-YC, 9 1/4" swing by 3' Bed Workshop Bench Lathe with Horizontal Motor Drive, reversing motor, and reversing switch. Shipping weight 320 lbs.....\$109.50

**INSIST—
ON THESE
FEATURES**

ONLY good shop equipment has the precision accuracy demanded in modern manufacturing plants, tool rooms, laboratories, machine shops and repair shops. South Bend Lathes are designed and built to assure this precision and to simplify the most difficult metal working jobs.

The South Bend 9" Workshop Lathe shown above is available in Model A with Quick Change Gear and Power Cross Feeds, Model B with Power Cross Feed, and Model C with Hand Cross Feed.

Catalog No. 50 illustrates and describes all models of the 9" lathe. Get a copy from your dealer, or write direct to company. Mailed Free on request.

SOUTH BEND LATHE WORKS

850 East Madison Street, South Bend, Indiana, U. S. A.

1. Back-geared headstock.
2. Hand-scraped V-ways on lathe bed.
3. Heat-treated alloy steel headstock spindle with precision ground bearing surfaces.
4. All steel and iron construction.
5. Precision machine cut gears.
6. Precision lead screw cuts screw threads to most exacting tolerances.
7. Ball thrust bearing for spindle.
8. Twin gear reverse on headstock for right and left hand threads and feeds.
9. Precision graduated steel micrometer collars on cross feed screw and compound rest screw.
10. Semi-steel lathe bed, heavily constructed.

ON DISPLAY IN ALL PRINCIPAL CITIES

Boston, Mass.—The MacKenzie Machinery Co.
Bridgeport, Conn.—A. C. Bisgood
Buffalo, N. Y.—R. C. Neal Company, Inc.
Cleveland, Ohio—Reynolds Machinery Co.
Dayton, Ohio—C. H. Gosiger Machinery Co.
Detroit, Mich.—Lee Machinery Company
Houston, Tex.—Wessendorff, Nelms & Company
Los Angeles, Cal.—Eccles & Davies Mach. Co.
Milwaukee, Wis.—W. A. Voell Machinery Co.

Newark, N. J.—J. R. Edwards Machinery Co.
New York, N. Y.—A. C. Colby Machinery Co.
Philadelphia, Pa.—W. B. Rapp, Machinery
Pittsburgh, Pa.—Tranter Manufacturing Co.
Portland, Ore.—Portland Machinery Company
Providence, R. I.—Geo. T. Reynolds & Son
Rochester, New York—Ogden R. Adams
San Francisco, Cal.—Moore Machinery Co.
York, Pa.—York Machinery & Supply Company

Popular sizes of South Bend Lathes are carried in stock for immediate delivery by dealers in 477 principal cities.

SOUTH BEND *Precision* **LATHES**



"Whose Vacation Is This, Anyway?"

CAMPING out is fun—if it doesn't last too long. We speak of "roughing it" and brag about the hardships entailed. But only a few years ago it wasn't considered a hardship to live this way. For most people, it was the only way they had to live.

The tin washtub, for instance. It did duty Monday mornings and Saturday nights, and the water was heated in the reservoir at the back of the wood-burning range. Splitting the wood was good exercise—but it was no fun to get up in the middle of cold nights to keep the fire going. And the feeble kerosene lamps, though an improvement over candles, had to be continually filled.

Sometimes we have to "rough it" to realize the improvements time has brought—many of them through electricity. Not only electric lights, and electric appliances to make housekeeping easier, but also automobiles, better roads, better coats and dresses.

Wherever electricity has been put to work in industry, it has brought us better-quality and lower-cost products. And because General Electric scientists, engineers, and workmen are finding still more ways to make electricity useful, we can look forward to still greater improvements in America's standard of living through the continued creation of More Goods for More People at Less Cost.

G-E research and engineering have saved the public from ten to one hundred dollars for every dollar they have earned for General Electric

GENERAL ELECTRIC

952-3E1

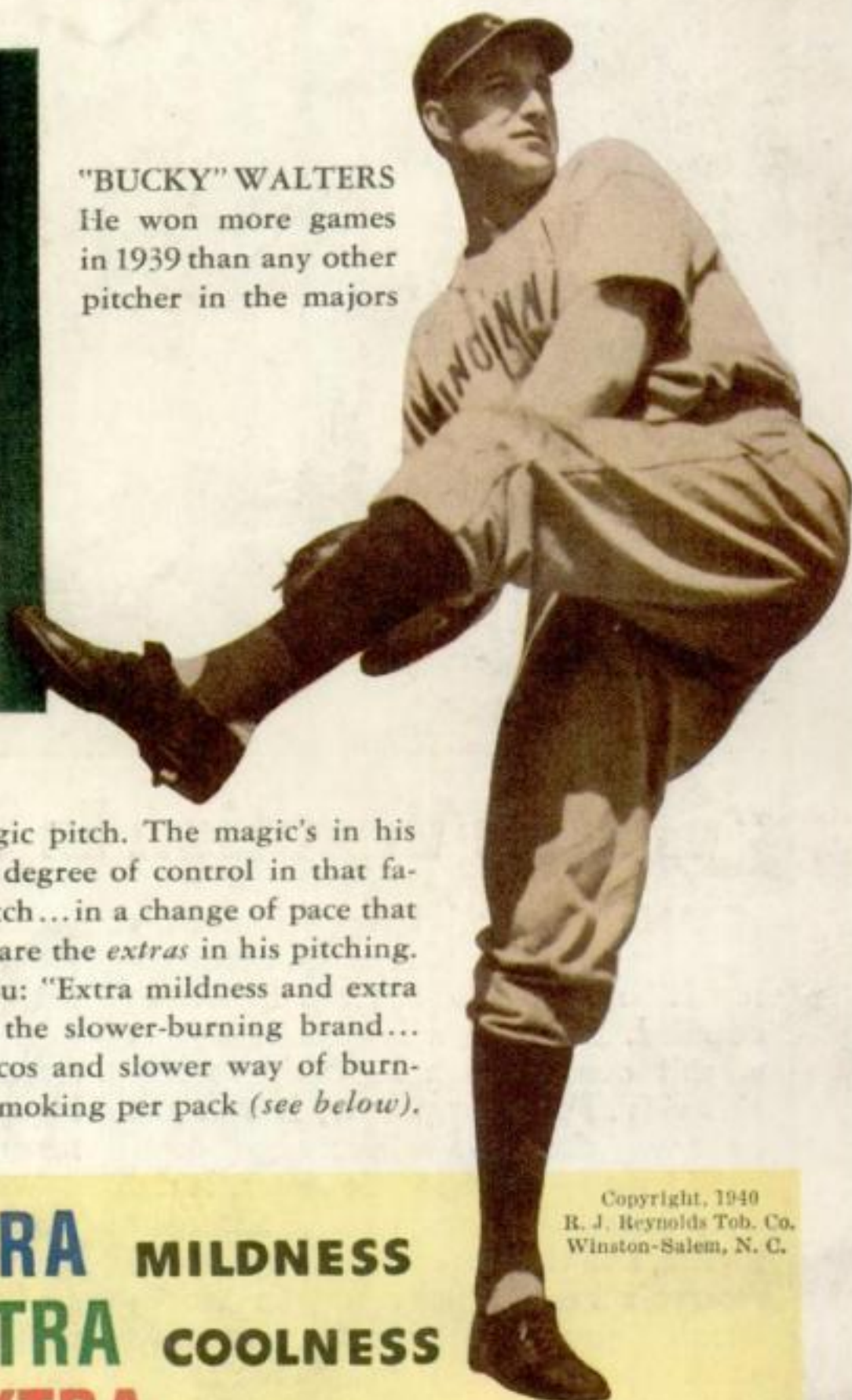
NEW YORK WORLD'S FAIR—SEE THE G-E "HOUSE OF MAGIC"—SAN FRANCISCO EXPOSITION

HE'S GOT THOSE EXTRAS THAT WIN BALL GAMES

Yes, it's the extras that carried "Bucky" Walters to the top. The extras of slower burning won him to Camel cigarettes



"BUCKY" WALTERS
He won more games
in 1939 than any other
pitcher in the majors



NO, "Bucky" Walters has no magic pitch. The magic's in his extra pitching sense—the extra degree of control in that famous right arm. It shows in every pitch...in a change of pace that shackles the mightiest of bats. Those are the *extras* in his pitching. In his cigarette, "Bucky" will tell you: "Extra mildness and extra coolness win with me. So I smoke the slower-burning brand... Camels." Yes, Camel's costlier tobaccos and slower way of burning mean extra pleasure—and extra smoking per pack (*see below*).



EXTRA MILDNESS
EXTRA COOLNESS
EXTRA FLAVOR

In recent laboratory tests, Camels burned 25% *slower* than the average of the 15 other of the largest-selling brands tested—*slower* than *any* of them. That means, on the average, a smoking *plus* equal to

5 EXTRA SMOKES PER PACK!

GET THE "EXTRAS"—WITH SLOWER-BURNING CAMELS
THE CIGARETTE OF COSTLIER TOBACCOS

Copyright, 1940
R. J. Reynolds Tob. Co.
Winston-Salem, N. C.